



**National Assessment of the Prescribing Practice and Quality
of Surgical Antibiotic Prophylaxis (SAP) in Obstetrics and
Gynaecological Surgery in Kuwait: Mixed Method Research**

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A thesis submitted in fulfilment of the requirements for the degree of Doctor
of Philosophy

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Glasgow, UK

December, 2025

Declaration

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Date: 15/12/2025

Acknowledgments

In the name of Allah, the Most Merciful, the Most Compassionate. I am deeply grateful to Allah, the Almighty, for granting me the faith, strength, and perseverance to complete this PhD.

I would like to express my sincere gratitude to all those who contributed to the successful completion of this PhD.

First and foremost, I would like to thank my supervisors, Professor Amanj Kurdi, Professor Anne Boyter, and Dr Ahmad Taqi, for their invaluable guidance, expertise, and continuous academic support throughout my PhD journey. Their critical insights, constructive feedback, and encouragement were instrumental in shaping this research and in developing my skills as an independent researcher.

I am also deeply grateful to my sponsor, the Civil Service Commission of Kuwait, for funding my PhD and for their continued support throughout my studies. This financial support enabled me to undertake and successfully complete this research.

I would like to thank Emma Dunlop for her time and support during my research. My sincere thanks also extend to Dr Fajer Alobaidan for her valuable assistance in facilitating data collection and coordinating access to relevant healthcare settings. I am equally thankful to all the directors, clinicians, and healthcare professionals across all participating hospitals in both the public and private sectors who generously gave their time to participate in surveys and interviews. Their cooperation, openness, and willingness to share their experiences were fundamental to the success of this study.

I would like to thank my colleagues (Faisal, Hisham, Yousef, Noor, Hanan, Solafa, Rahaf, Irin, Aimee, Liya, and Eve) for their encouragement, shared experiences, and insightful discussions throughout my PhD journey. Their support and companionship made this experience both enriching and enjoyable.

I would like to express my deepest gratitude to my family and friends for their unwavering support, patience, and understanding throughout my PhD. I am especially thankful to my dear wife, Dina, for her constant encouragement and support during this journey. I am also deeply grateful to my beloved daughter, Maria, whose presence brought joy, balance, and motivation during this demanding period. Their love and support made the completion of this work possible.

Finally, I would like to thank everyone who contributed directly or indirectly to this research but may not be named individually. This thesis would not have been possible without the collective support, guidance, and encouragement I received throughout my PhD journey.

Abstract

Inappropriate surgical antibiotic prophylaxis (SAP) contributes to avoidable adverse events, antimicrobial resistance and unnecessary costs. Despite the importance of SAP in obstetrics and gynaecological (OB/GYN) surgery, Kuwait has lacked national evidence to guide SAP practice. This thesis aimed to assess the SAP prescribing practices across Kuwait and explore behavioural and system-level factors influencing the practice with an ultimate goal of improving the quality of SAP prescribing through tailored antimicrobial stewardship interventions to the Kuwait healthcare system.

A sequential mixed-method approach was used. First, a national point prevalence survey (PPS) was conducted across nine hospitals to assess SAP practice including compliance against local and international guidelines. The survey showed poor compliance level, extensive broad-spectrum antibiotic use, incorrect SAP timing, prolonged postoperative antibiotic use and poor documentation. The second stage involved a national Knowledge, Attitude, and Practice (KAP) survey of prescribers, which showed low overall knowledge, common misconceptions and beliefs and wide variation in self-reported practice. The final qualitative study used Capability, Opportunity, Motivation-Behaviour (COM-B)-guided interviews to explore behavioural and organisational factors, which revealed gaps in training, strong influence from patient and seniors, defensive prescribing and limited guideline accessibility. Collectively, this thesis provided the first national assessment of SAP in OB/GYN surgery in Kuwait and identified potential AMS interventions tailored

to the local context. Notably, despite Kuwait being a high-income country, the prescribing practices were found to be more comparable in quality to those reported in low-income settings, highlighting the need for tailored stewardship regardless of resource level.

Thesis summary

Background:

Surgical antibiotic prophylaxis (SAP) is a vital preventive measure for reducing the risk of surgical site infections (SSIs). Despite the availability of evidence-based guidelines, suboptimal SAP prescribing remains common worldwide. Inappropriate SAP practices, such as incorrect timing, unnecessary use of broad-spectrum agents, prolonged post-operative duration, and prescribing to patients who are not eligible for SAP, are frequently reported. These deviations from recommended practice are associated with poorer surgical outcomes, increased risk of antibiotic-related adverse events (including allergic reactions, acute kidney injury, and gastrointestinal complications), and contribute substantially to the global burden of antimicrobial resistance (AMR). The World Health Organization (WHO) has identified AMR as a critical global health threat and emphasises antimicrobial stewardship (AMS) and antibiotic-use surveillance as core components of its global action plan to curb the rapid spread of resistance.

In obstetric and gynaecological (OB/GYN) surgery, the consequences of rising AMR can be particularly severe, given the high surgical rate and the vulnerability of this patient population. Although OB/GYN surgery plays an important role in Kuwait's healthcare system, national data on SAP practice in this speciality are scarce. Also, although Kuwait is classified as a high-income country, prior regional data and the findings of this thesis suggest that SAP prescribing quality may not align with practices in other high-income countries

and, in some respects, resembles prescribing patterns documented in lower-income settings. This evidence gap limits understanding of current prescribing practices and hinders the evaluation and development of antimicrobial stewardship initiatives to improve SAP prescribing.

Aim: This thesis aimed to explore the SAP prescribing practices in OB/GYN surgery in Kuwait and identify opportunities for improvement, with the ultimate goal of informing stewardship interventions to enhance prescribing quality and reduce inappropriate antibiotic use.

Methods: An explanatory sequential mixed-methods design was employed, consisting of three interconnected studies to explore and explain SAP prescribing practice in Kuwait. The first phase involved a national multicentre Point Prevalence Survey (PPS) conducted between 15 December 2022 and 15 March 2023 across nine public and private hospitals. Using an adapted WHO and Global-PPS methodology, the PPS systematically assessed SAP prescribing in obstetric and gynaecological surgeries by collecting standardised patient-level and medication-level data. Information was recorded on SAP indication, antibiotic selection, dose, route, and timing of administration, as well as post-operative continuation and overall appropriateness according to both international and available local guidelines. The survey also captured hospital-level characteristics and guideline availability. Data were analysed descriptively, supported by comparative

analyses and multilevel logistic regression to identify institutional and clinical predictors of inappropriate SAP prescribing.

The second phase involved employing a national cross-sectional knowledge, attitude, and practice (KAP) between 9 July and 10 October 2023 among obstetricians, gynaecologists, and anaesthetists responsible for SAP prescribing. The survey explored clinicians' baseline knowledge, attitudes towards guidelines, and self-reported practices. The questionnaire was developed using findings from Chapter 2, current SAP guidelines (ACOG, 2018), and published literature, and was designed to comprehensively assess clinicians' SAP-related knowledge, attitudes towards guideline adherence, and self-reported prescribing behaviours. Data were collected via Qualtrics® and paper-based forms across public and private hospitals.

The third phase employed a qualitative study using semi-structured interviews with obstetricians and gynaecologists working in public and private hospitals across Kuwait. The interviews were conducted between 25 December 2023 and 25 January 2024 and were guided by a topic schedule informed by findings from Chapters 2 and 3 and structured using the Capability, Opportunity, and Motivation–Behaviour (COM-B) model. Participants were recruited through purposive and snowball sampling until data saturation was achieved. Coding was conducted both inductively and deductively within the COM-B structure to identify behavioural and contextual determinants of SAP prescribing. Identified

barriers and facilitators were subsequently mapped onto the Behaviour Change Wheel (BCW) to highlight feasible stewardship interventions.

Results: The PPS showed that SAP was widely used across OB/GYN procedures, but prescribing quality varied considerably between hospitals. Inappropriate practice was mainly driven by prolonged postoperative use, inconsistent timing, selection of broad-spectrum agents, escalation, and poor documentation. Private hospitals tended to prescribe more broader-spectrum antibiotics and for longer durations. In hospitals with local SAP guidelines (n = 187), only five patients (2.7%) were fully compliant with local guidelines. Across all hospitals (n= 238), only 15 patients (6.3%) were fully compliant with ACOG guidelines. Most of the prescribed antibiotics were from the WHO Watch-list. A multilevel logistic regression analysis confirmed that the absence of local guidelines and ward speciality were the main risk factors associated with inappropriate prescribing.

The KAP survey (n=123) provided further insight into the behavioural and knowledge-related factors underlying the inappropriate SAP practices identified in the PPS. Although guideline awareness was high, overall knowledge of SAP principles was low (105/123, 85.4%), particularly regarding timing, antibiotic selection, and recommended duration. Attitudes were generally neutral (67/103, 65.0%), yet several misconceptions persisted, especially beliefs favouring broader-spectrum antibiotics and prolonged post-operative use. Self-reported practice was generally adequate (52/91, 57.1%)

and often contrasted with evidence-based recommendations, mirroring the trends observed in the PPS. Better Knowledge and attitude were both associated with better practice, indicating that gaps in understanding and motivation contribute directly to suboptimal prescribing. Participants strongly prioritised the creation of a national SAP guideline, followed by education and audit-feedback mechanisms, highlighting opportunities for targeted stewardship interventions.

The qualitative study (n=13) revealed that SAP prescribing in Kuwait is shaped by a mix of behavioural, organisational and cultural factors. Gaps in SAP documentation, limited training, and reliance on personal experience rather than guidelines reduced clinicians' capability to prescribe appropriate SAP. Opportunity-related barriers, such as inconsistent guideline accessibility, lack of national guideline, minimal audit system, and strong senior peer influence, further influenced the practice. Motivational-related barriers included preventative mindset, fear of complications and defensive prescribing. Patient expectation, cultural hygiene practices and workload pressure further reinforced the inconsistent practice. Overall, inappropriate SAP use stems from rooted norms and system-level gaps rather than individual knowledge gaps, highlighting the need for tailored AMS intervention

Conclusion: This thesis presented the first national, mixed-method assessment of SAP prescribing in OB/GYN surgery in Kuwait. Across all studies, inappropriate SAP use was prevalent, particularly regarding antibiotic

selection, timing and prolonged postoperative duration, highlighting critical gaps in both practice and system-level governance. By integrating the findings from the PPS, KAP survey and qualitative interviews, this study provides a comprehensive understanding of the clinical, behavioural and organisational factors driving inappropriate SAP prescribing. Collectively, these insights could inform AMS recommendations tailored to Kuwait's healthcare system. Beyond its national relevance, this thesis contributes to the global evidence on SAP prescribing and antimicrobial stewardship in OB/GYN surgery. A key finding is that HIC status does not protect against suboptimal prescribing practice: Kuwait's results were broadly comparable to those reported from lower-income settings, providing lessons applicable to any healthcare system where governance, guidelines, and stewardship infrastructure remain underdeveloped.

Thesis structure

The thesis is organised into five chapters, each contributing to a comprehensive understanding of SAP prescribing practice in OB/GYN surgery in Kuwait.

Chapter One

Provides the background and context of surgical site infections (SSIs), the role of SAP, and the consequences of inappropriate antibiotic use in surgery. It reviews global and regional SAP prescribing practice and guideline adherence, identifying gaps in the literature specific to Kuwait. The chapter also introduces the mixed-methods research design and presents the study's aims, objectives, and rationale.

Chapter Two

This chapter aims to evaluate national SAP prescribing practices in OB/GYN surgery across Kuwait. It applies a Point Prevalence Survey (PPS) methodology adapted from WHO/Global-PPS protocols. The chapter outlines the study setting, inclusion/exclusion criteria, data collection process, and outcome measures. The chapter presents findings on SAP prevalence, appropriateness, commonly prescribed antibiotics based on WHO's AWaRe classification, prescribing duration, and factors contributing to inappropriate prescribing. Key findings showed high SAP prevalence, substantial guideline non-adherence, particularly for timing and duration and wide variation between hospitals.

Chapter Three

This chapter aims to assess the knowledge, attitudes and practice (KAP) of OB/GYN surgeons and anaesthetists regarding SAP prescribing and guideline adherence. It employs a cross-sectional KAP questionnaire. The chapter details the survey design, development, distribution process, and statistical analyses. Key findings revealed generally low knowledge, inconsistent attitudes, and notable variation in SAP practice, highlighting gaps between perceived and recommended prescribing behaviour.

Chapter Four

This chapter aims to identify and explore barriers and facilitators for appropriate SAP prescribing and guideline compliance in OB/GYN surgery in Kuwait. It uses semi-structured interviews analysed through thematic analysis structured around the COM-B (capability, opportunity, motivation-behavioural). This chapter describes the development of the topic guide, recruitment strategy, analytical approach, and ethical considerations. Key findings identified multiple barriers, including limited guideline accessibility, reliance on habitual practice, and workflow constraints. Facilitators included training, collaboration, and institutional support.

Chapter Five

This chapter synthesises the findings from all studies, integrating quantitative and qualitative evidence. It discusses their implications for clinical practice, antimicrobial stewardship, and policymaking in OB/GYN surgery. The chapter

concludes with recommendations for implementing context-specific stewardship interventions within Kuwait's healthcare system and outlines strategies to reduce AMR.

List of conference publications

Alshatti, F., Boyter, A. & Kurdi, A., 2025. Knowledge gaps influencing inappropriate surgical antibiotic prophylaxis prescribing in Kuwait: qualitative study. *Research in Social and Administrative Pharmacy*, 21(11), p.e62. Available at: <https://doi.org/10.1016/j.sapharm.2025.06.068> (Poster presentation).

Alshatti, F., Kurdi, A., Boyter, A. & Taqi, A., 2024. A national point prevalence survey to assess surgical antibiotic prophylaxis duration and timing in obstetrics and gynaecological surgery in Kuwait. *International Society for Pharmacoepidemiology Annual Meeting 2024*, Berlin, Germany, 24–28 August 2024. (Poster presentation).

Alshatti, F., Kurdi, A., Boyter, A. & Taqi, A., 2024. Assessment of surgical antibiotic prophylaxis appropriateness in obstetrics and gynaecological surgery in Kuwait: a national point prevalence survey. *International Society for Pharmacoepidemiology Annual Meeting 2024*, Berlin, Germany, 24–28 August 2024. (Poster presentation).

Alshatti, F., Kurdi, A., Boyter, A. & Taqi, A., 2024. Knowledge, attitude and practice of obstetricians and gynaecologists towards appropriate surgical antibiotic prophylaxis prescribing in obstetric and gynaecological surgery in Kuwait: a national cross-sectional survey. *International Society for Pharmacoepidemiology Annual Meeting 2024*, Berlin, Germany, 24–28 August 2024. (Poster presentation).

Alshatti, F., Kurdi, A., Boyter, A. & Taqi, A., 2024. Prevalence and patterns of antibiotic prophylaxis in Kuwaiti obstetric and gynaecological surgery: a national point prevalence survey. *International Society for Pharmacoepidemiology Annual Meeting 2024*, Berlin, Germany, 24–28 August 2024. (Poster presentation).

Alshatti, F., Kurdi, A., Boyter, A., Alali, A. & Taqi, A., 2023. National assessment of prescribing practice of antibiotic prophylaxis among obstetrics and gynaecological surgeries in Kuwait. *European Drug Utilization Research Group Conference 2023*, Bologna, Italy, 27-30 June 2023. (Poster presentation).

Alshatti, F., Kurdi, A., Boyter, A., Alali, A. & Taqi, A., 2024. National assessment of surgical antibiotic prophylaxis appropriateness in obstetrics and gynaecological surgeries in Kuwait: point prevalence survey. *SIPBS Postgraduate Research Day*, Glasgow, United Kingdom, 6 June 2024. (Oral communication).

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List of Abbreviations

AMR	Antimicrobial resistance
AWaRe	Access, Watch and Reserve classification
ACOG	American College of Obstetricians and Gynecologists
AKI	Acute kidney injury
AMS	Antimicrobial stewardship
ASA	American Society of Anesthesiology
ASHP	American society of health system Pharmacist guidelines
ASP	Antimicrobial Stewardship Program
BMI	Body mass index
C-section	Caesarean sections
<i>C. diff</i>	<i>Clostridioides difficile</i>
CDC	Centres for Disease Control
COVID-19	Coronavirus disease 2019
<i>E. coli</i>	<i>Escherichia coli</i>
ECDC	European Centre for Disease Prevention and Control
ESBL	Extended-spectrum <i>beta-lactamase</i>
GCC	Gulf Cooperation Council
HCAIs	Healthcare-associated infections
HIC	High-income countries
ICU	Intensive care unit
INICC	International Nosocomial Infection Control Consortium
IPC	Infection prevention and control
KAP	Knowledge attitudes and practice
LMICs	Low- and middle-income countries
MDRO	Multidrug-resistant organisms
MENA	Middle East and North Africa
MOH	Ministry of Health
MRSA	<i>Methicillin-resistant S. aureus</i>
NDM	New Delhi Metallo-Beta-Lactamase
NHSN	National Healthcare Safety Network
NICE	National Institute for Health and Care Excellence
OB/GYN	Obstetrics and Gynaecology
OECD	Organisation for Economic Co-operation and Development
SAP	Surgical antibiotic prophylaxis
SIGN	Scottish Intercollegiate Guidelines Network
SSI	Surgical site infection
VTE	Thromboembolism
WHO	World Health Organization

Chapter 1. Introduction

1.1. Overview of surgical site infection

1.1.1. Definition of surgical site infection

Surgical site infection (SSI) is an infection that occurs after an invasive surgical procedure. It happens either at or near the site of the incision, and manifests within 30 days of the procedure or within 90 days of a prosthetic implantation procedure (Horan *et al.*, 1992; Owens *et al.*, 2008; Centers for Disease Control and Prevention, 2025). SSIs are classified into three categories: superficial incisional, deep incisional, and organ or body space infections (Figure 1.1).

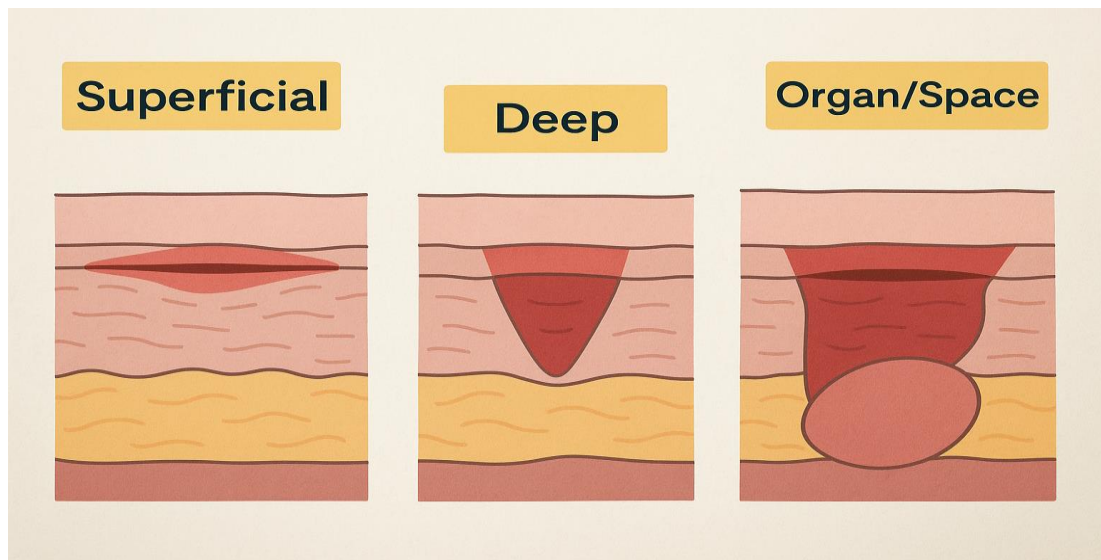


Figure 1.1: Classification of SSIs, highlighting superficial, deep, and organ/space involvement (author's own illustration) adapted from (Owens *et al.*, 2008)

In addition, the CDC wound classification system categorised surgical wounds (defined as any incision or operative site created during a surgical procedure) into four classes (clean, clean-contaminated, contaminated, and dirty or infected) based on microbial contamination and operative conditions (Table

1.1). This classification supports the assessment of SSI risk across procedures alongside other key predictors such as the American Society of Anesthesiology (ASA) score and operation duration (Horan *et al.*, 1992; Centers for Disease Control and Prevention, 2025).

Table 1:1: Surgical wound classification according to the Centers for Disease Prevention and Control(Centers for Disease Control and Prevention, 2025)

Wound class	Description
Class I – Clean Elective, non-traumatic No inflammation No break in sterile technique No entry into respiratory, GI, genital, or urinary tracts	Primarily closed incision
Class II – Clean-contaminated Minor break in sterile technique No unusual contamination	Controlled entry into respiratory, GI, genital, or urinary tract
Class III – Contaminated Major break in sterile technique Gross spillage from GI tract Acute, non-purulent inflammation	Open, fresh wounds (<4 hours)
Class IV – Dirty or Infected Existing clinical infection Purulence or perforated viscera	Old traumatic wounds (>4 hours)

1.1.2. Surgical site infections as a global burden

According to the World Health Organization (WHO), SSIs are the most frequently reported healthcare-associated infection (HCAI) in low- and middle-income countries (LMICs) and the second most prevalent infection in high-income countries (HICs), with LMICs incidence rates reaching up to 30%, depending on the setting and procedure type (Allegranzi *et al.*, 2011; World Health, 2011; Vandael *et al.*, 2020; Centers for Disease Control and Prevention, 2025). In Europe, a recent multicentre point prevalence survey

showed that the rate of SSI among 662,309 surgical procedures across 11 European countries ranged from 0.6% to 9.6%, with the highest rates observed following open colon surgery (ECDC, 2024). In the Middle East, a multicentre surveillance study conducted by the International Nosocomial Infection Control Consortium (INICC) across 29 hospitals in five countries (Bahrain, Egypt, Kuwait, Lebanon, and Saudi Arabia) reported 304 SSIs among 21,322 surgical procedures between 2014 and 2023 (Rosenthal *et al.*, 2024). Procedure-specific analysis revealed that coronary artery bypass (4.5%), open reduction of fracture (2.5%), and exploratory abdominal surgery (3.8%) had SSI rates significantly higher than the Centers for Disease Control and Prevention/National Healthcare Safety Network (CDC/NHSN).

SSIs impose significant clinical, economic, and societal burdens on patients and healthcare systems (Vippadapu *et al.*, 2022). In the United States, SSIs affect over 500,000 patients annually, contributing to 3,000 deaths and costing between \$3.5 billion and \$10 billion each year (Perencevich *et al.*, 2003; Maraş *et al.*, 2023; Centers for Disease Control and Prevention, 2025). A recent multicentre study found that hospital-reported SSIs were associated with an average cost of \$29,638 per patient and extended hospital stays by 10.7 days, compared to non-SSI admissions (Ai *et al.*, 2025). Estimates suggest that SSIs can increase healthcare costs by between \$3,000 and \$29,000 per patient in HICs (Iskandar *et al.*, 2019; Centers for Disease Control and Prevention, 2025). In LMICs, the burden is more severe, with SSI rates reaching up to 30% in high-risk contaminated procedures, especially emergency abdominal,

gastrointestinal, and obstetric surgery, which significantly increase treatment costs for each case and often lead to catastrophic financial hardship for patients and their families (World Health Organization, 2018a; Monahan *et al.*, 2020).

Clinically, SSIs are associated with higher hospital readmission rates, increased risk of hospital-onset bacteraemia or fungemia, and approximately a threefold increase in mortality compared with patients without such infections (Ai *et al.*, 2025). For example, in orthopaedic procedures, patients with SSIs had significantly higher 12-month mortality rates than those without (Shambhu *et al.*, 2024). Additionally, SSIs are associated with delayed discharge to home, increased intensive care unit (ICU) utilisation, and longer duration of mechanical ventilation, especially in trauma and abdominal surgery (Rayzah, 2025).

Beyond the financial and clinical impact, SSIs also contribute to psychological distress, including anxiety and depression, and can significantly reduce patient's quality of life long after the infection resolves (Perencevich *et al.*, 2003). This impact has been quantified in a meta-analysis, which found that SSIs are associated with a mean reduction of 0.08 (95% CI -0.11 to -0.05) in EQ-5D (EuroQoL five dimensions; a quality-of-life measure) utility scores, with deep infections showing an even greater mean decrement of 0.10 (95% CI -0.14 to -0.06) (McFarland *et al.*, 2023). This difference is statistically significant and exceeds many accepted minimal clinically important differences for EQ-

5D, suggesting a meaningful decline in health-related quality of life among patients who experience SSIs. Patients with SSIs often experience loss of productivity, prolonged disability, and strain on caregivers, amplifying the societal burden (Totty *et al.*, 2021).

Given the association between SSIs, adverse outcomes, and escalating healthcare costs, reducing the SSI rate is a critical priority in both global and across the Middle East region (Monahan *et al.*, 2020; Hirani *et al.*, 2022; Rosenthal *et al.*, 2024). In Kuwait rising SSI rates following obstetrics surgery highlight the need for targeted local action (Alfouzan *et al.*, 2019). Moreover, targeted efforts are needed in high-volume surgical fields such as obstetrics and gynaecology (OB/GYN), where procedural frequency and patient vulnerability heighten the risk of SSI.

1.1.3. Surgical Site Infections burden on obstetrics and gynaecology surgery.

Globally, the volume of OB/GYN surgery has increased over the past decades; Caesarean section (C-section) accounts for 28-30 million procedures annually, and is projected to reach 38 million by 2030 (Betran *et al.*, 2021). Approximately 10.0% of patients undergoing OB/GYN procedures are estimated to develop an SSI, with rates in LMICs ranging from 2.5% to 41.9%, depending on the setting and procedure type (Clifford *et al.*, 2012; World Health Organization, 2021b; Kulkarni *et al.*, 2023). OB/GYN surgery encompasses a broad range of procedures that vary significantly in terms of their invasiveness, complexity, and associated SSI risk. Table 1.2 provides an

overview of the major obstetric and gynaecological surgical procedures relevant to this thesis, categorised by subspeciality and procedure type. Understanding the different types of OB/GYN surgical procedures is important for interpreting antibiotic prescribing practices, as the indication for prophylaxis, the appropriate antibiotic selection, and the SSI risk profile differ substantially across procedure types.

Table 1:2 Overview of obstetric and gynaecological surgical procedures

Subspeciality	Procedure	Invasiveness
Obstetrics	Caesarean section (elective or emergency)	Major open
	Instrumental delivery (forceps/vacuum)	Vaginal-assisted
	Manual removal of placenta	Uterine/vaginal
	Evacuation of retained product of conception (D&C)	Uterine/vaginal
	Cervical cerclage	Vaginal
Gynaecology-major	Abdominal hysterectomy (total/subtotal)	Major open
	Vaginal hysterectomy	Major open
	Laparoscopic/robotic hysterectomy	Minimally invasive
	Open myomectomy	Major open
	Oophorectomy/ salpingo-oophorectomy	Major open or laparoscopic
	Laparotomy for ovarian mass	Major open
Gynaecology-minor/endoscopic	Operative hysteroscopy (myomectomy, polypectomy, adhesiolysis)	Endoscopic
	Diagnostic hysteroscopy	Minimal
	Laparoscopic ovarian cystectomy	Laparoscopic or open
	Tubal ligation	Minimal
	Diagnostic laparoscopy	Minimal
	Endometrial biopsy	Minimal
	Intrauterine device (IUD) insertion	Minimal

SSI incidence in obstetric procedures is generally lower than in gynaecological surgery, with rates of 1.2% and 10.3%, respectively (Petca *et al.*, 2022). Regional data from the INICC surveillance report from five Middle Eastern countries (Bahrain, Egypt, Kuwait, Lebanon, and Saudi Arabia) found SSI rates of 1.2% for abdominal hysterectomy and 1.0% for C-section (Rosenthal *et al.*, 2024). In Kuwait, hospital-based surveillance revealed that SSIs following C-section increased from 1.7% in 2014 to 2.9% in 2016 (Alfouzan *et al.*, 2019). Another study showed that SSI rates in abdominal hysterectomy ranged from 2.3% to 8.1% (Yang *et al.*, 2024).. A recent systematic review and meta-analysis in Saudi Arabia reported a 3.0% prevalence of SSI post-C-section (Alshahrani *et al.*, 2025).

Clinically, SSIs in OB/GYN surgery are also associated with increased morbidity, longer hospital stays, higher readmission rates, and a greater risk of sepsis, particularly in LMICs where access to timely care may be limited (Yang *et al.*, 2024; Taliento *et al.*, 2025). Psychologically and socially, SSIs in OB/GYN surgery can lead to postpartum anxiety, depression, and reduced maternal-infant bonding, especially when infections delay recovery or require re-hospitalisation (Albaharnah *et al.*, 2024; Liseth *et al.*, 2024). These complications also contribute to increased healthcare costs, particularly in high-volume procedures like C-section (Zuarez-Easton *et al.*, 2017; Petca *et al.*, 2022).

1.2. Surgical site infections: risk factors and microbiology.

1.2.1. Risk factors for OB/GYN

Risk factors associated with SSIs in OB/GYN are generally classified into two categories: patient-related and procedure-related. Patient-related factors include modifiable risks such as obesity, diabetes, and poor nutritional status, and non-modifiable risks such as age. Procedure-related factors are also categorised into preoperative, intraoperative, and postoperative phases (Table 1.3) (Owens *et al.*, 2008; Florschutz *et al.*, 2015; Petca *et al.*, 2022; Yang *et al.*, 2024; Taliento *et al.*, 2025).

Table 1:3: Risk factors for surgical site infections

Patient-related	Procedure-related
Modifiable risk factors	Pre-operative
Poor nutrition	Surgical history
Uncontrolled Diabetes mellites	Poor skin and hair antiseptic preparation
Obesity (BMI* > 30)	Inappropriate surgical antimicrobial prophylaxis timing
Long hospital stays	
Smoking and alcohol consumption	
Co-exist infection	
Chorioamnionitis,	
Prolonged rupture of membranes	
Prolonged labour	
Non-modifiable risk factors	Intraoperative
Age (less than 18 and over 40)	Surgery duration > 5 hours
Recent radiotherapy	Operating room environment
History of skin infections	Surgeon's technique and skill
Immunocompromised patients (HIV, immunosuppression medication)	Poor sterilisation of surgical instruments
	Emergency vs elective
	Blood loss >1500mL
	Post-operative
	Poor dressings
	Retained of foreign body at surgical site
	Dirty or contaminated wound
	Poor glycaemic control

Note: BMI: Body Mass Index

Recent studies have reinforced the importance of these classifications. For example, a 2025 meta-analysis identified obesity (Body Mass Index [BMI] > 30 kg/m²), diabetes, blood transfusion, and tumour presence as significant independent risk factors for SSIs following hysterectomy (Liu *et al.*, 2025). Similarly, a large cohort study in New York found that obesity, diabetes, open surgical approach, prolonged procedure (> 186 minutes), and contaminated wound classification significantly increased SSI risk in abdominal hysterectomy patients (Tserenpuntsag *et al.*, 2023).

In C-section, a prospective study in Ethiopia reported an SSI incidence of 19.7%, with key risk factors including high BMI, delayed antibiotic prophylaxis, longer operation time, and extended labour duration (Shacho *et al.*, 2025). Another UK-based surveillance report by Public Health England highlighted advanced age, elevated BMI, type of surgery, and hospital readmission as major contributors to SSI risk (Public Health England, 2020).

1.2.2. Microbiology of surgical site infection in OB/GYN

SSIs in OB/GYN typically arise from endogenous pathogens originating from the patient's own flora. The specific organisms isolated depend on the surgical site (Dohmen, 2006; Owens *et al.*, 2008). The exogenous sources, such as contaminated surgical instruments, operating room environment, and healthcare personnel, also contribute to SSI risk but are less common with standard asepsis (Owens *et al.*, 2008; Prtak *et al.*, 2009).

The most frequently isolated pathogens in OB/GYN SSIs include:

- Gram-positive bacteria, including *Staphylococcus aureus* (including methicillin-resistant *S. aureus* [MRSA]), coagulase-negative staphylococci, and *Enterococcus spp.*
- Gram-negative bacteria, including *Escherichia coli* (*E. coli*), *Klebsiella pneumoniae*, *Enterobacter spp.*, and *Pseudomonas aeruginosa* (Ziogou *et al.*, 2023; Rezaei *et al.*, 2025).

The emergence and spread of antimicrobial resistance (AMR) in surgical settings pose a major threat to both prophylactic and therapeutic strategies. Key resistant pathogens include MRSA, extended-spectrum β -lactamase-producing *Enterobacteriaceae* (ESBL), such as *E. coli* and *Klebsiella spp.*, and carbapenem-resistant organisms, including *Klebsiella pneumoniae* and *Acinetobacter spp.* (Nimer, 2022; Husna *et al.*, 2023). A Malaysian cohort study found that 42.1% of SSI isolates were multidrug-resistant organisms (MDROs) (Muhamad *et al.*, 2025). In Gulf Cooperation Council (GCC) reports, Gram-negative organisms dominate in 70–88% of SSI isolates, and MDROs are common (Hamza *et al.*, 2018; Alfouzan *et al.*, 2019; Alshammari *et al.*, 2020; Alsareii, 2021). Given the growing prevalence of resistant organisms in surgical infections, it is essential to understand the broader concept and mechanisms of antimicrobial resistance.

1.3. Overview of antimicrobial resistance

1.3.1. Definition of antimicrobial resistance

AMR is defined as “*the ability of a microorganism (including fungi, viruses, bacteria, and protozoa) to resist the effect of one or more antimicrobial agents, thereby reducing prophylaxis and treatment efficacy of SSI*” (World Health Organization, 2015). The rise of drug-resistant pathogens has led to treatment failures and increased mortality (World Health Organization, 2025a). The term ‘antimicrobials’ encompasses all classes of anti-infective medications, including antibiotics, antivirals, antifungals, and antiparasitics.

Among these, bacterial resistance is considered the most urgent threat due to the limited development of new antibiotics and declining effectiveness of many existing agents (Melchiorri *et al.*, 2025; World Health Organization, 2025a). While AMR is partly a natural evolutionary process, its spread has been dramatically accelerated by human misuse and overuse of antimicrobials (Rice, 2008; Sartelli *et al.*, 2020). This challenge is further compounded by the emergence and spread of MDR pathogens, defined as “*bacteria resistant to multiple classes of antibiotics, which present significant obstacles to clinical practice*” (Aslam *et al.*, 2018).

1.3.2. Causes of antimicrobial resistance

The global spread of AMR is driven by multiple factors, including antibiotic overuse in humans, animals, and agriculture; selection pressure; inadequate sanitation and sewage disposal; poor infection control; substandard antimicrobials; and lack of awareness (Aslam *et al.*, 2018; World Health

Organization, 2025a). In the GCC region, several region-specific factors exacerbate the AMR crisis, as described by the WHO as one of the top global public health threats (World Health Organization, 2025a). These include the limited implementation and effectiveness of antimicrobial stewardship programmes (ASPs) (Ababneh *et al.*, 2021), poor adherence to infection control measures, and the high influx of expatriates, tourists, and pilgrims to Mecca, which increases the risk of transmission of resistant pathogens (Balkhy *et al.*, 2016). Additional factors include patient non-compliance with prescribed antimicrobial courses, over-the-counter sales of antimicrobials, lack of knowledge, overuse of antimicrobials in animals and agriculture, and, most importantly, the inappropriate prescribing of antimicrobials in hospitals (Al-Tawfiq *et al.*, 2010).

1.3.3. Antimicrobial resistance global and regional impact

The WHO has identified AMR as one of the major global threats to public health for humans, animals and plants (World Health Organization, 2025a). In OB/GYN surgery, antimicrobials, particularly surgical antibiotic prophylaxis (SAP), are important to prevent SSIs and ensure safe maternal outcomes. However, the rise in AMR undermines these benefits, leading to higher medical costs, prolonged morbidity, and increased mortality (Dadgostar, 2019).

Recent evidence shows that AMR is already a major global health burden. A global analysis in 2019 revealed that AMR was directly responsible for 1.27

million deaths and associated with 4.95 million deaths worldwide (Murray, 2022). The most recent WHO GLASS report showed that AMR was linked to approximately 1.14 million deaths in 2021 and adopted the 2019 estimate of 4.95 million AMR-associated deaths as the global baseline for AMR monitoring (World Health Organization, 2025b). In addition, global modelling of trends from 1990 to 2021 forecasts that, without effective intervention, AMR-attributable mortality could reach approximately 1.9 million deaths per year by 2050, with up to 8.2 million deaths annually associated with AMR (GBD 2021 Antimicrobial Resistance Collaborators, 2024). A report by the Organisation for Economic Co-operation and Development (OECD) estimated that, over the next 30 years, 2.4 million deaths could occur in high-income countries (North America, Europe, Australia), with associated healthcare costs of \$3.5 billion each year (Cassini *et al.*, 2019; Hofer, 2019). In the United States, AMR affects nearly 3 million people and causes over 35,000 deaths each year (CDC, 2019).

In OB/GYN, the WHO warns that the AMR makes procedures like C-section and gynaecological surgery more risky as resistant infections are difficult to treat and may lead to a longer hospital stay, increased medical costs and a higher mortality rate (World Health Organization, 2025a). A study on maternal infections during pregnancy found that AMR significantly affected outcomes, especially in peripartum infections, which can lead to complications for both mother and newborn. Newborn babies are particularly vulnerable to resistant pathogens as their immune systems are immature, and inadequate

management of infection due to AMR can result in severe maternal and neonatal morbidity (Vlad *et al.*, 2025).

AMR rates are rising significantly across the GCC (Devi, 2019). In Saudi Arabia, studies report high resistance rates among key pathogens relevant to SSIs (Thabit *et al.*, 2023). For example, 35.7% of *Klebsiella pneumoniae* isolates were ESBL producers, and 51.8% were resistant to carbapenems (AlKhaldi *et al.*, 2025). Another study showed that nearly 94.4% of *Acinetobacter* isolates were resistant to most antibiotics, including carbapenems (Alqurashi *et al.*, 2025). A retrospective observational study of paediatric bloodstream infections conducted in a single tertiary hospital in Qatar, found that MDRO accounted for 3 out of 4 infection-related deaths among children with bloodstream infections (Al-Mulla *et al.*, 2014). Additionally, MRSA colonisation among healthcare workers remains a concern, with 45.0% of all *S. aureus* isolates identified as MRSA in a Saudi tertiary hospital (Al-Humaidan *et al.*, 2015).

Although research from GCC countries consistently demonstrates increasing AMR among surgical pathogens, there is a lack of region-specific research, particularly in Kuwait, directly evaluating the clinical impact of AMR on surgical outcomes, especially in OB/GYN procedures. Nevertheless, the rapid rise of AMR highlights the urgent need for global surveillance, responsible antibiotic use, and coordinated action to contain its spread and preserve the effectiveness of existing treatments.

1.3.4. Surgical site infection preventive measures

Prevention of SSIs is critical due to the rising volume of surgical procedures globally (Sartelli *et al.*, 2021). In response to the growing need for safer surgical practice, the WHO launched the “Safe Surgery Saves Lives” initiative in 2007, which introduced a 19-item Surgical Safety Checklist (Haynes *et al.*, 2009). This checklist is built around ten core safety standards aimed at enhancing surgical outcomes and reducing complications.

The checklist ensures that surgical procedures are performed on the correct patient and at the correct site, and that teams are prepared for potential complications such as blood loss or cardiac and respiratory emergencies. It also promotes effective communication among surgical team members, including surgeons, anaesthetists, and nursing staff, through structured briefings and debriefings. Importantly, the checklist reinforces adherence to evidence-based prophylactic measures, including venous thromboembolism (VTE) prevention and administering SAP (Haynes *et al.*, 2009; Braham *et al.*, 2014; World Health Organization, 2018a; Centers for Disease Control and Prevention, 2025; Rezaei *et al.*, 2025).

Building on this initiative, SSI prevention bundles emerged in the early 2000s as a structured, evidence-based approach to reduce SSI. A bundle is defined as a small set of evidence-based practices that, when implemented together and consistently, result in significantly better outcomes than when applied individually (Petca *et al.*, 2022; Ching, 2024). These bundles typically include

preoperative, intraoperative, and postoperative preventative measures (Table 1.4) (Owens *et al.*, 2008; Petca *et al.*, 2022; Ziogou *et al.*, 2023; Ching, 2024).

International health bodies, such as the WHO, CDC and National Institute for Health and Care Excellence (NICE), have adopted the use of SSI prevention bundles, emphasising their role in standardising care and reducing SSI (Al-Aabri *et al.*, 2016; Allegranzi *et al.*, 2016; Berrios-Torres *et al.*, 2017; Petca *et al.*, 2022; Ching, 2024). The effectiveness of these bundles has been demonstrated in OB/GYN surgery. For example, a meta-analysis of 14 studies involving over 17,000 women undergoing C-section found that SSI rates dropped from 6.2% to 2.0% after bundle implementation (Carter *et al.*, 2017). Similarly, in another study of 2,099 hysterectomy cases, SSI rates declined from 4.5% to 1.9% following the introduction of a gynaecology-specific bundle (Andiman *et al.*, 2018). Among these prevention bundles, the administration of SAP demonstrated significant benefit to many different types of surgical procedures, including OB/GYN, to reduce the risk of SSI (Moreno-Drada *et al.*, 2016; Sartelli *et al.*, 2016; World Health Organization, 2018a; World Health Organization, 2021b).

Table 1:4: Summary of preoperative, intraoperative and postoperative interventions to prevent surgical site infections

Preoperative intervention	Intra-operative intervention	Post-operative intervention
Timely antimicrobial prophylaxis (within 60 min of incision)	Skin antisepsis with alcohol-based CHG or povidone-iodine	Appropriate wound care and dressing changes
Smoking cessation	Redosing of antimicrobial prophylaxis when indicated	Early mobilisation
Nutritional assessment and optimisation	Maintenance of normothermia ($\geq 35.5^{\circ}\text{C}$)	Continued glycaemic control
Management of modifiable risk factors (e.g., obesity)	Adequate oxygenation	Monitoring for early sign of infection
Preoperative bathing with chlorhexidine (CHG)	Use of wound protectors in GI and OB/GYN surgery	Avoid unnecessary drains/catheters
Hair removal with clippers (not razors)	Strict adherence to sterile surgical technique	
Vaginal preparation when indicated	Reduces contamination and SSI risk, especially in C-section and hysterectomy	
Glycaemic control in diabetic patients		

1.4. Overview of surgical antibiotic prophylaxis

1.4.1. Definition

The WHO (2018a), defines surgical antibiotic prophylaxis as *“the prevention of infectious complications by administering an effective antimicrobial agent prior to exposure to contamination during surgery”*.

1.4.2. Principles of appropriate surgical antibiotic prophylaxis

Appropriate SAP is a cornerstone in preventing SSIs, which remain the most common and costly HCAs globally. A systematic review by the European Centre for Disease Prevention and Control (ECDC) found that correct preoperative antibiotic use can prevent up to 80.0% of SSIs. (European Centre for Disease Prevention and Control, 2013). In OB/GYN surgery, Cochrane reviews showed that SAP reduces SSI and endometritis rates in C-section by 60–70% and lowers wound and pelvic infections after hysterectomy by nearly 50% when administered correctly (Smaill *et al.*, 2014; Ayeleke *et al.*, 2017). The appropriate use of SAP contributes to improved surgical outcomes and helps combat the growing threat of AMR (Sartelli *et al.*, 2021).

To further support clinicians in optimising SAP prescribing in OB/GYN surgery, guidelines have been developed, emphasising six key prescribing parameters (Table 1.5) (Bratzler *et al.*, 2013; Scottish Intercollegiate Guidelines Network, 2014; Berrios-Torres *et al.*, 2017; Ierano *et al.*, 2017; American College of Obstetricians and Gynecologists, 2018; World Health Organization, 2018a; National Institute for Health and Care Excellence (NICE), 2019; Centers for Disease Control and Prevention, 2025). However, inappropriate use,

particularly poor timing, can increase SSI risk up to fivefold, especially when antibiotics are given more than 120 minutes before incision (Leaper *et al.*, 2015; de Jonge *et al.*, 2017b). Prolonged SAP has not shown additional benefit and instead increases medical costs and the risk of adverse effects such as acute kidney injury (AKI), *Clostridioides difficile* infection, rashes, pruritus, and drug toxicity, as well as driving AMR (Bronzwaer *et al.*, 2002; Mullish *et al.*, 2018; World Health Organization, 2018a; Branch-Elliman *et al.*, 2019; Dadgostar, 2019).

The emergence of AMR undermines the effectiveness of SAP, and thus the safety of surgical procedures, leading to an increase in the SSI rate. Optimising SAP is essential to maintaining and advancing surgical practice, preventing adverse outcomes and reducing the growth of AMR.

Table 1:5: Comparative summary table of Surgical Antibiotic Prophylaxis recommendations across major international guidelines

Prescribing Parameter	CDC (2025)	WHO (2018)	SIGN (2014)	ASHP (2013)	NICE (2019)	ACOG (2018)
Indication	SAP recommended for clean-contaminated and contaminated procedures; not for clean or dirty wounds unless implants are used.	Same as CDC	Same as CDC.	Same as CDC.	Same as CDC.	Same as CDC.
Selection	Narrow-spectrum agents preferred; cefazolin recommended.	Cefazolin preferred	Cefazolin or alternatives based on procedure.	Cefazolin; alternatives for allergies or resistance.	Cefazolin or narrow-spectrum antibiotic.	Cefazolin alternatives for allergies.
Dose	2g cefazolin, Weight-based dosing; redosing if >2 half-lives or major blood loss.	Same as CDC	Dose adjusted for weight and renal function.	2g cefazolin IV standard; adjust for weight.	Dose per standard; redose if prolonged surgery.	2g cefazolin IV; adjust for BMI.
Route	IV preferred; topical agents not recommended.	IV preferred; topical discouraged.	IV or IM; topical not advised.	IV administration standard.	IV preferred; topical discouraged.	IV for OB/GYN; topical not used.
Timing	Within 60 min before incision; 120 min for vancomycin/fluoroquinolones.	Same as CDC	Same as CDC	Within 60 min; 120 min for slow infusions.	Within 60 min; 120 min for slow infusions.	Within 60 min before incision.
Duration	Single dose or ≤24 hrs; no post-op doses for clean/clean-contaminated.	Single dose preferred; ≤24 hrs max.	Same as CDC	Same as CDC	Same as CDC use.	Same as CDC

CDC: Centers for Disease Control and Prevention (USA); **WHO:** World Health Organization (Global); **SIGN:** Scottish Intercollegiate Guidelines Network (UK); **ASHP:** American Society of Health-System Pharmacists (USA); **NICE:** National Institute for Health and Care Excellence (UK); **ACOG:** American College of Obstetricians and Gynecologists (USA). **IV:** intravenous; **OB/GYN:** obstetrics and gynaecology; **BMI:** body mass index.

1.5. Current prescribing practice of surgical antibiotic prophylaxis

1.5.1. Global data

Despite the availability of evidence-based SAP guidelines (Bratzler *et al.*, 2013; Scottish Intercollegiate Guidelines Network, 2014; American College of Obstetricians and Gynecologists, 2018; National Institute for Health and Care Excellence (NICE), 2019), inappropriate SAP prescribing remains a widespread issue globally, especially in LMICs. Poor adherence to clinical guidelines is a major contributing factor, with common deviations including incorrect timing, inappropriate dosing, and prolonged postoperative prophylaxis. These practices not only compromise patient safety but also exacerbate the global threat of AMR (Gouvea *et al.*, 2015; Mwita *et al.*, 2021).

A global PPS conducted across 303 hospitals in 53 countries found that 34.4% of 86,776 adult patients were prescribed at least one antimicrobial. Among these, 17.8% were prescribed for surgical prophylaxis, while SAP in OB/GYN accounted for only 3.0% of total antibiotic prescriptions (Versporten *et al.*, 2018). The relatively low proportion in OB/GYN may reflect the generally lower infection risk compared to other high-risk surgical specialities such as orthopaedic, gastrointestinal, or cardiothoracic surgery. However, SAP was prolonged beyond 24 hours in 40.6% to 86.3% of cases, contravening international recommendations that advocate for a single preoperative dose or a maximum duration of 24 hours. This widespread non-compliance is often attributed to inconsistent local guidelines, lack of enforcement, and

misconceptions among prescribers regarding the benefits of extended prophylaxis (Versporten *et al.*, 2018).

The same study highlighted significant documentation gaps: the indication for antibiotic use was recorded in only 76.9% of cases and stop or review dates were documented in just 38.3% of cases. Additionally, local guidelines were unavailable for 19.2% of prescriptions, while compliance with existing protocols was 77.7% (Versporten *et al.*, 2018). These findings underscore the need for robust antimicrobial stewardship programmes (ASPs), as such programmes promote adherence to evidence-based guidelines, provide ongoing staff education, and enable regular audit and feedback. This is all essential to improving antibiotic use, particularly in LMICs, where limited staff training and inadequate monitoring further compound the issue.

Another global PPS reported that SAP was prescribed for more than 24 hours in 69.3% of cases. The survey also noted a high reliance on antibiotics from the WHO's "Watch" list, especially in Asia and Africa, raising further concerns about AMR. The "Watch" list forms part of the WHO AWaRe classification (Access, Watch, Reserve) used to guide stewardship efforts. "Watch" antibiotics include broad-spectrum agents such as third-generation cephalosporins, fluoroquinolones, and macrolides, which are associated with a higher potential for driving AMR and therefore should be used with caution. Guidelines specifically addressing SAP were unavailable in 24.9% of

participating countries, indicating a substantial gap in standardised prescribing practice (Pauwels *et al.*, 2021a; Pauwels *et al.*, 2021b).

Country-specific data reinforce these global trends. In Belgium, a PPS across 110 acute care hospitals found that only 35.1% of patients received single-dose SAP, while 25.2% were administered prolonged prophylaxis. Moreover, 60% of prescriptions lacked a stop or review date, and only 76.6% complied with local guidelines (Vandael *et al.*, 2020). A study in two Peruvian hospitals found that only 3.9% of OB/GYN surgery fully complied with antibiotic prophylaxis guidelines, with frequent issues in timing, duration, antibiotic selection (broad-spectrum combinations) and post-discharge antibiotic prescribing (Arteaga-Livias *et al.*, 2023). Conversely, a longitudinal PPS in Ireland demonstrated notable improvements between 2009 and 2015. The proportion of SAP prescriptions exceeding 24 hours decreased from 3.9% to 0.7%, and guideline compliance increased from 54.5% to 79.9% (Al-Taani *et al.*, 2018). This improvement was due to multifaceted ASP interventions, including the introduction of antimicrobial pharmacists, regular stewardship ward rounds, restriction of high-risk antibiotics, use of biomarker data, annual updates to antibiotic policies, and antibiotic cycling strategies. These coordinated interventions significantly enhanced guideline compliance and reduced prolonged use of SAP (Al-Taani *et al.*, 2018).

Nevertheless, inappropriate SAP practice persists in both developed and developing countries. The 2016 England PPS reported that 30.8% of SAP

prescriptions were inappropriate, primarily driven by prolonged postoperative continuation (21.3%) and unnecessary additional doses (Higgins *et al.*, 2023). In Australia, the 2017 National Antimicrobial Prescribing Survey (NAPS) found that 43.0% of SAP prescriptions were inappropriate. Of 4,507 preoperative prescriptions, only 46.1% adhered to national guidelines, 8.3% followed local policies, and 38.3% were non-compliant. The most frequent issues included incorrect timing (45.7%), unnecessary postoperative prescribing (40.3%), and prolonged SAP duration ranging from 1 to 11 days (National Centre for Antimicrobial Stewardship and Australian Commission on Safety and Quality in Health Care, 2017). A subsequent analysis of 15,395 SAP prescriptions revealed that only 48.7% were appropriate, with the remainder primarily affected by incorrect timing (44.9%) and extended duration over 24 hours (54.3%) (Ierano *et al.*, 2019a). In Italy, a paediatric hospital study found that only 5.7% of children received the correct antibiotic choice, 48.6% received SAP at the recommended timing, and just 14.5% received SAP for the appropriate duration, with only 1.6% of procedures fully adhering to all guideline components (Giordano *et al.*, 2017).

Evidence from LMICs, consistently demonstrate concerning SAP prescribing practice in OB/GYN surgery. In Liberia, an observational cross-sectional study found that only 22.0% of OB/GYN surgery adhered to SAP timing guidelines, with 78.0% non-compliant despite training interventions, highlighting that education alone is insufficient to change prescribing behaviour (Enriquez *et al.*, 2022). Similarly, an audit in Nigeria across tertiary hospitals found

suboptimal SAP prescribing in OB/GYN surgery, with only 16.5% of cases meeting recommended timing and none adhering to duration guidelines, averaging 8.7 days of use. Broad-spectrum combinations and redundant anaerobic coverage were common, with metronidazole accounting for 86.6% of total consumption. (Abubakar *et al.*, 2018). A subsequent, a multicentre point prevalence survey (PPS) in Northern Nigeria confirmed similar patterns, showing that all SAP prescriptions exceeded the recommended 24-hour duration and that one-third involved broad-spectrum agents (Abubakar, 2020). All these studies share common methodological limitations including, retrospective or cross-sectional designs, and small sample size.

A recent mixed-methods study at Ain Shams University Hospital in Egypt reviewed 280 OB/GYN procedures and found no full adherence to SAP guidelines. While 62.5% used the correct antibiotic, only 38.2% met the recommended timing. Notably, 93.9% involved prolonged parenteral use beyond 24 hours, and 98.9% continued with oral antibiotics post-discharge for up to seven days (Ali *et al.*, 2025). Moreover, a recent PPS in Tanzania revealed significant gaps in SAP prescribing in OB/GYN. Among OB/GYN procedures, none adhered fully to international SAP guidelines. Prolonged prophylaxis was common, with most patients receiving antibiotics beyond the recommended 24-hour window. The most frequently prescribed regimen was ampicillin-cloxacillin plus metronidazole, often continued unnecessarily. Additionally, documentation was poor, as over 83.0% of prescriptions lacked

a stop/review date, and rationale for use was rarely recorded (Schrama *et al.*, 2025).

Poor adherence to SAP guidelines in LMICs might be driven by a combination of individual, institutional, and systemic factors. These include limited training and awareness among prescribers, inadequate antimicrobial stewardship infrastructure, insufficient access to recommended antibiotics, and poor monitoring and documentation systems (Cooper *et al.*, 2020; Hassan *et al.*, 2021; Mwita *et al.*, 2021). The absence of updated local guidelines and poor dissemination of existing protocols further exacerbate the issue (Cooper *et al.*, 2020). Additionally, workflow inefficiencies, hierarchical prescribing culture, and lack of professional autonomy often hinder timely and appropriate SAP administration (Wæhle *et al.*, 2019; Hassan *et al.*, 2021). Overall, these findings collectively suggest that SAP practice is suboptimal worldwide. Non-adherence to guidelines contributes to poor clinical outcomes and increases the risk of severe adverse effects.

1.5.2. Regional data

Compared to the global SAP practices, GCC countries have also shown similar antibiotic use and inappropriate SAP practice. In Saudi Arabia, a national PPS in 26 hospitals across the country found that antibiotic use was extremely high as almost half (46.9%) the patients (4,535) received one or more antibiotics, and 45.7% of all antibiotic prescriptions were for SAP. Among these SAP prescriptions, compliance with local or international guidelines was low

(48.1%), and documentation of SAP indication in patient files was recorded in only about half of cases (51.1%). Moreover, 78.0% of surgical patients received prolonged, unnecessary SAP over 24 hours, when a single dose was the appropriate recommendation (Al Matar *et al.*, 2019).

Another retrospective analysis of SAP prescriptions in Saudi Arabia found that 78.0% of 118 patients received perioperative antibiotics, and 61.0% were recommended. SAP was overused in most cases: 39.0% of SAP prescriptions were not recommended. Of the recommended SAP, 19.4% had incorrect timing, 26.4% received an inadequate antibiotic choice, 69.4% received a suboptimal dose, and 59.7% had prolonged unnecessary prophylaxis. In this study, the overall SAP compliance with guidelines was achieved in only 15.0% of patients (Tolba *et al.*, 2018). Another Saudi Arabian study assessing the adherence to SAP guidelines in a tertiary care hospital found that only 20.0% of 707 cases received SAP according to guidelines. The reasons for non-adherence were incorrect timing in 77.5% of patients, and 56.4% had prolonged SAP duration (Alahmadi *et al.*, 2020). Likewise, a study in the UAE also showed major flaws in SAP practice; a study found that of 250 patients, 98.8% received SAP. However, the antibiotic selection was appropriate for only 25.0% of the patients. In addition, only 30.0% of the patients received SAP at the correct timing, 60.0% received more than a single dose of SAP, and 30.0% had unnecessarily prolonged SAP (El Hassan *et al.*, 2015).

A questionnaire-based survey evaluating general surgeons' adherence to the American Society of Health-System Pharmacists (ASHP) guidelines for SAP in Saudi Arabia revealed widespread non-compliance. Most respondents deviated from recommended practice regarding antibiotic selection, indication, timing, and duration of SAP, and prescribed prophylaxis for longer than the recommended one-day period. Notably, 52.0% of participating surgeons cited drug unavailability as the primary reason for inappropriate SAP prescribing (Alotaibi, 2020). Another study in Saudi Arabia justified the poor practice of perioperative prophylaxis, specifically the inappropriate choice of antibiotics, mainly due to the unavailability of antibiotics (Nehad J. Ahmed *et al.*, 2015). This shows that drug availability could be a major factor influencing SAP prescribing, thus ensuring supply chain and drug availability could improve the practice.

In Bahrain, a study assessing surgeons' adherence to national and local guidelines for SAP in plastic surgery revealed suboptimal compliance. Only 19.8% of cases met the recommended criteria for antibiotic selection and dosing, while correct timing of SAP administration was observed in just 11.5% of procedures (AlAlwani *et al.*, 2021). Similar patterns of SAP non-compliance were observed in studies from Oman and Qatar, where hospitals demonstrated widespread deviations from guideline recommendations. Two regional studies highlight similar patterns of inappropriate SAP use. In Qatar, Abdel-Aziz *et al.* (2013) found that non-adherence was mainly driven by unnecessarily prolonged postoperative antibiotics in 59.3% of cases and

inappropriate antibiotic selection in 31.5%. Similarly, in Oman, El-Shoubary *et al.* (2015) reported prolonged SAP duration in 69.0% of patients.

Data on the appropriateness of SAP prescribing in Kuwait remains limited. The only audit available, conducted in 2012, assessed physician adherence to local guidelines and found that SAP was the leading indication for antibiotic prescribing. However, optimal SAP adherence to guidelines was achieved in only 37.0% of all prescriptions. Notably, the audit did not provide details regarding SAP dose, duration, or timing, leaving critical gaps in understanding prescribing quality or any data regarding SAP in OB/GYN surgery (Aly *et al.*, 2012).

These studies collectively reveal an extensive overuse and inappropriate prescribing of SAP across the GCC countries. The most frequent deviations involve prolonged antibiotic administration beyond 24 hours, and inappropriate antibiotic selection (El-Shoubary *et al.*, 2015; Nehad J. Ahmed *et al.*, 2015; Al Matar *et al.*, 2019; Alahmadi *et al.*, 2020). A recent systematic review of ASP implementation in the Middle East, published in 2021, analysed 20 studies conducted between 2005 and 2020 and found that research on antimicrobial stewardship in the region remains limited, with few healthcare institutions successfully implementing comprehensive ASPs (Ababneh *et al.*, 2021). The review primarily focused on hospital-wide ASP initiatives and highlighted several effective strategies, including prospective audit and feedback, pre-authorisation, tracking, education, restriction policies, de-escalation, and

intravenous-to-oral switch (IVOST), that were associated with reduced AMR rates and lower antibiotic consumption (Ababneh *et al.*, 2021). However, the review did not identify SAP-specific stewardship interventions, underscoring the need for dedicated ASP strategies targeting surgical prophylaxis. This gap is relevant for GCC countries, including Kuwait, where national policies and SAP-focused stewardship efforts are urgently needed to optimise SAP use and reduce the risk of SSI and AMR.

1.5.3. Factors associated with inappropriate SAP prescribing

A systematic review by Hassan *et al.* (2021) examined studies published between 1998 and 2018 and identified several determinants that directly contribute to inappropriate SAP prescribing. These included inadequate knowledge and skills, personal beliefs, limited access to or awareness of guidelines, organisational and systemic constraints, inconsistent drug availability, and negligence. These findings highlight the urgent need to enhance clinicians' awareness, attitudes, and behaviours regarding SAP. Recent studies have further elaborated on these findings, revealing that inappropriate SAP prescribing arises from a complex interplay of individual, institutional, and systemic factors shapes adherence to SAP guidelines (Ierano *et al.*, 2019b; Sefah *et al.*, 2024; Giblin *et al.*, 2025; Narayan *et al.*, 2025).

In HICs, barriers often relate to behavioural and organisational dynamics. For instance, a mixed-methods study in Ireland found that junior clinicians frequently deferred SAP decisions to senior staff due to lack of confidence and

unclear role delineation, despite having access to guidelines and stewardship support (Giblin *et al.*, 2025). Conversely, in LMICs, structural challenges such as limited access to updated guidelines, inadequate training, and resource constraints are more prominent (Sefah *et al.*, 2024). A qualitative study in Georgia highlighted that hospitals with active ASPs and interprofessional collaboration showed significantly better SAP compliance, underscoring the importance of institutional support in reducing inappropriate SAP prescribing (Narayan *et al.*, 2025).

Furthermore, hierarchical prescribing culture presents a significant obstacle in LMICs, where junior staff often adhere to habitual or senior-led practice, even when these contradict with evidence-based recommendations, which can lead to inappropriate SAP prescribing (Sefah *et al.*, 2024). Conversely, HICs generally encourage multidisciplinary decision-making and regular audit-feedback mechanisms, which support improved adherence with SAP guidelines (Bandaru *et al.*, 2025). However, even in HICs, the absence of clear local guidelines and poor documentation has been shown to hinder SAP optimisation, particularly relating to timing and duration (Ierano *et al.*, 2019b).

These findings suggest that while some barriers, such as a lack of awareness and unclear guidelines, are universal, others are context-specific. Tailored strategies are therefore required to address the behavioural, organisational, and systemic contributors to inappropriate prescribing. These include structured clinician education, improved access to clear and procedure-

specific guidelines, well-resourced ASPs, and supportive institutional policies. Qualitative research remains crucial in identifying the behavioural and cultural factors driving inappropriate SAP use, guiding targeted interventions in both LMICs and HICs (Broom *et al.*, 2021).

To address these challenges, global efforts must focus on strengthening ASP, optimising SAP prescribing practice, and implementing targeted interventions, particularly among surgeons and anaesthetists, to mitigate the spread of AMR and improve surgical outcomes.

1.5.4. Antimicrobial stewardship

Previous studies have linked rising antibiotic consumption with the acceleration of AMR (van de Sande-Bruinsma *et al.*, 2008; Bell *et al.*, 2014). As AMR continues to rise and new antibiotics remain scarce, preserving the effectiveness of existing antibiotics is critical. Antimicrobial stewardship (AMS) refers to coordinated strategies that promote the appropriate use of antimicrobials to improve patient outcomes, reduce misuse, and combat resistance (World Health Organization, 2019b). The WHO Global Action Plan on AMR recommends that all healthcare systems implement Antimicrobial Stewardship Programmes (ASPs). These programmes, alongside infection prevention and control (IPC) and patient safety, are essential for strengthening healthcare systems.

To support these efforts, the WHO introduced the AWaRe classification (Access, Watch, Reserve) as a framework to guide antibiotic prescribing and surveillance (World Health Organization, 2019a). Access antibiotics are recommended as first-line agents with lower resistance potential; Watch antibiotics require cautious use due to their higher resistance risk; and Reserve antibiotics are last-line agents reserved for MDRO infections. When combined with surveillance tools, like the AWaRe classification, AMS can help optimise antibiotic use (World Health Organization, 2019b).

In the United States of America (USA), the CDC launched formal ASP guidance in 2014, outlining seven core elements: leadership commitment, accountability, pharmacy expertise, action, tracking, reporting, and education, which were later updated in 2019 (Centers for Disease Control and Prevention, 2019). The 2015 USA National Action Plan mandated all federally funded hospitals to implement these core elements, assigning a physician and a pharmacist as programme leaders to oversee implementation, ensure resource allocation, monitor antimicrobial use, report resistance patterns, and educate clinicians on optimal prescribing and AMR risks (Centers for Disease Control and Prevention, 2015).

The main goals of ASPs are to optimise antibiotic use, improve patient outcomes, extend the lifespan of existing antibiotics, reduce unnecessary costs, and promote a culture of rational prescribing among clinicians (World Health Organization, 2019b). The OECD emphasised that implementing AMS,

alongside measures such as improving hospital hygiene, could prevent 1.6 million deaths by 2050 and save \$4.8 billion annually across 33 OECD countries (Organisation for Economic Co-operation and Development, 2018).

While ASPs have demonstrated significant success in HIC, implementation in LMICs remains limited due to resource constraints, inadequate infrastructure, and lack of trained personnel (Kpokiri *et al.*, 2020). To address these challenges, the WHO has developed a practical toolkit to support LMICs in designing and implementing tailored ASPs adapted to their healthcare settings (World Health Organization, 2019b). In the Middle East, several countries have made notable progress. For instance, Saudi Arabia, Qatar, Jordan, and Lebanon have implemented ASPs with varying degrees of success. A systematic review found that common ASP practices in the region include prospective auditing and feedback, antibiotic restriction, education, and intravenous-to-oral switch strategies (Ababneh *et al.*, 2021). However, significant challenges persist, including the lack of published data from Kuwait, limited financial and human resources, inadequate policy and leadership support, and insufficient monitoring and evaluation mechanisms (Ababneh *et al.*, 2021). These findings highlight the need for developing and implementing tailored ASP in the Middle East, especially in Kuwait.

1.5.5. Antimicrobial stewardship programme team and interventions

An ASP committee is typically a multidisciplinary team that includes a microbiologist, an infectious diseases physician, an antimicrobial pharmacist,

an infection control nurse, a consultant physician, and a data analyst. This team collaborates to optimise patient outcomes and ensure safe and effective antimicrobial use (Majumder *et al.*, 2020). The CDC outlines seven core elements essential for effective ASP, including leadership commitment, accountability, pharmacy expertise, implementation of targeted actions (such as pre-authorisation and prospective audit and feedback), tracking antimicrobial use and resistance, regular reporting, and ongoing education (Centers for Disease Control and Prevention, 2019). In addition to these core elements, ASP interventions can be broadly categorised into measures taken before or at the time of prescribing and those implemented after prescribing (Table 1.6) (Chung *et al.*, 2013; World Health Organization, 2021a).

Table 1:6: Summary of ASP Interventions and Their Rationales

Category	Intervention	Rationale
Before or at the time of prescription	Clinical education	Keeps clinicians updated on evidence-based practices and AMR awareness.
	Patient & public education	Promotes responsible antibiotic use among the public.
	Local guideline development	Standardises prescribing and supports audits.
	Cumulative antibiogram	Informs empirical therapy and guideline development.
	Pre-authorisation & restriction	Controls use of high-risk antibiotics and improves communication.
	De-labelling false allergies	Enables use of first-line agents, reduces adverse events and costs.
After prescription	Prospective audit & feedback	Allows real-time optimisation and supports prescriber autonomy.
	Antibiotic timeouts (self-reassessment)	Encourages reassessment of ongoing therapy.
	Dose optimisation	Improves outcomes and reduces unnecessary exposure.
	Duration optimisation	Minimises prolonged use and associated risks.

In surgical settings, ASPs are particularly effective in standardising SAP practice, reducing unnecessary use of broad-spectrum agents, and ensuring appropriate timing, choice, and duration of prophylaxis (Sartelli *et al.*, 2016). Thus, by implementing these interventions, ASPs not only reduce SSI and

AMR rates but also strengthen compliance with hospital and international guidelines.

Global evidence has demonstrated the effectiveness of such interventions. A comprehensive Cochrane review by Davey *et al.* (2017), which included 221 studies, showed that stewardship interventions significantly improved compliance with recommended antibiotic policies. The review also reported improvements in appropriate prescribing and a reduction of two days in the duration of antibiotic therapy, without any increase in mortality, treatment failure, or length of stay. They suggested that restrictive strategies have shown immediate improvement, while enabling strategies, such as audit and feedback, were more associated with sustained behavioural change among prescribers. Similarly, a systematic review and meta-analysis by Schuts *et al.* (2016), analysing 145 studies examining nine AMS objectives such as de-escalation, IV-to-oral switching, and dose and duration, showed that these routine practices significantly improved patient outcomes and reduced unnecessary antibiotic use.

In addition to global evidence, SAP-specific improvements have also been reported. A five-year retrospective study in Costa Rica to assess the impact of several AMS interventions, including education, monitoring, and direct feedback to the prescriber on SAP prescribing (Díaz-Madriz *et al.*, 2023). The study showed a significant improvement in the SAP appropriateness from

20.0% to 80.0% and optimal duration from 69.0% to 78.0% with less utilisation of broad-spectrum antibiotics without increasing SSI rates.

Collectively, these findings highlight that AMS interventions, especially those including education, guideline support, and audit-feedback, are effective in improving SAP prescribing and provide a strong foundation for designing targeted stewardship efforts in Kuwait.

1.6. An overview and summary of the healthcare system in Kuwait

Kuwait is a high-income country located in the Arabian Peninsula, in the Middle East and North Africa (MENA) region. It borders Saudi Arabia to the south and Iraq to the north (Figure 1.2). Kuwait is a member of the Gulf Cooperation Council (GCC), a political and economic alliance formed in 1981 that includes Saudi Arabia, Bahrain, Oman, Qatar, and the United Arab Emirates. Arabic is the primary language across GCC countries, and citizens can travel freely between countries (World Bank Country and Lending Groups, 2022).

Kuwait has a population of approximately 4.8 million, with Kuwaiti nationals making up around 32% and the rest is a large expatriate community (Central Statistical Bureau, 2025). Despite its harsh climate and limited natural resources, the country has developed into a high-income economy, primarily driven by its vast oil reserves. These reserves contribute significantly to government revenues and exports. Oil wealth has driven fast urban growth and investment in infrastructure, education, and public services, influencing

the development of Kuwait's healthcare system. This sector continues to be a key area, supported by government funding and policies.



Figure 1.2: Map illustrating Kuwait's geographical location.

1.6.1. Healthcare system

Kuwait's healthcare system is divided into public and private sectors. The Ministry of Health (MOH) is the primary provider in the public sector, offering free healthcare to Kuwaiti nationals and GCC citizens. Expatriates, however, require a health coverage plan through either the public or private sector (World Health Organization, 2017). Other public institutions, such as the Ministry of Defence and the Kuwait Oil Company Hospital, also contribute to service provision; however, the MOH oversees national healthcare policy and development.

The healthcare system in Kuwait comprises six health regions: Kuwait City, Hawalli, Farwaniya, Mubarak Al-Kabir, Al Ahmadi, and Al-Jahra. It is structured around three levels of care: primary, secondary, and tertiary. Primary care serves as the first contact point and is delivered through a widespread network of centres nationwide. These centres provide a variety of services, including preventive, curative, and specialised clinics, covering services such as maternal and child health, chronic disease management, dental care, and general practice.

Secondary care is delivered through seven general hospitals covering the country's six health regions, with the Kuwait City health region served by two hospitals (Table 1.7) (Kelendar H, 2019; Central Statistical Bureau, 2025). These hospitals feature outpatient, inpatient, and emergency services, offering a wide range of specialties such as internal medicine, paediatrics, obstetrics and gynaecology, surgery, orthopaedics, dermatology, ophthalmology, psychiatry, and trauma care.

Tertiary care is mainly provided by specialised hospitals and national centres, mostly situated in the Al-Sabah health region. These institutions offer advanced services including oncology, neurosurgery, plastic and reconstructive surgery, burns treatment, rehabilitation, and highly specialised maternity care. While most healthcare needs are satisfied in the country, Kuwaiti citizens can be referred abroad for treatments that are unavailable locally.

Under the New Kuwait 2035 Vision, the government is expanding its healthcare infrastructure, with over 20 strategic projects underway as of 2025. These include the newly opened Maternity Hospital in Al-Sabah and the construction of the New Al-Sabah Hospital, featuring 780 beds and 72 outpatient clinics (Kuwait Direct Investment Promotion Authority, 2022).

Table 1:7: Secondary hospital distribution across governorate and bed capacity and population within governorate information

Hospital	Capacity	OB/GYN Department	Governorate	Population in each governorate
Jahra Hospital	1,171	Yes	Al Jahra	566,861
Amiri Hospital	478	No	Kuwait City	574,839
Maternity Hospital, Al Sabah	406	Yes		
Jaber Al Ahmad Hospital	1,168	Yes	Hawalli	926,170
Mubarak Al Kabeer Hospital	718	No	Mubarak Al-Kabeer	279,666
Farwaniya Hospital	1,082	Yes	Al-Farwaniya	1,109,819
Al Adan Hospital	1,447	Yes	Al Ahmadi and Mubarak Al Kabeer	1,203,450

Sources: (Kuwait Direct Investment Promotion Authority, 2022; Central Statistical Bureau, 2025)

1.6.2. Private sector in Kuwait

In Kuwait over the past two decades the private sector has advanced substantially, helping and complementing the public sector. It is primarily utilised by expatriates and higher-income Kuwaitis looking for faster and

advanced medical care. As of 2023, more than 20 private hospitals and over 300 specialised medical centres operate in Kuwait under the regulation of the MOH (Kuwait Direct Investment Promotion Authority, 2022). These hospitals and facilities are mainly located in Kuwait City and high expatriate areas like Farwaniya and Hawalli, offering a broad range of services including OB/GYN.

1.6.3. Organisation of obstetric and gynaecological care in Kuwait

In Kuwait, OB/GYN services are provided through both public and private healthcare sectors. Most major public hospitals have dedicated OB/GYN departments offering a comprehensive range of services such as antenatal and postnatal care, normal and caesarean deliveries, high-risk pregnancy management, infertility assessments, family planning, and gynaecological surgery. Public hospitals also provide emergency obstetric care and neonatal services, including neonatal intensive care in larger facilities, to ensure continuous maternal and infant health support.

The organisation of OB/GYN care follows the national referral system. Women typically begin their care at primary healthcare centres, where they receive routine antenatal check-ups, preventive services, and basic investigations. If specialised care is needed, they are referred to secondary hospitals for further assessment, inpatient services, and delivery. More complex cases, especially those involving high-risk pregnancies, obstetric complications, or subspecialist gynaecological treatment, are referred to tertiary hospitals and specialised centres, mostly located in the Al Sabah health region.

Private hospitals also offer advanced OB/GYN services, including antenatal and postnatal care, neonatal intensive care units, and both minimally invasive and major gynaecological procedures. These facilities often allow patients to bypass the public referral system and access specialist care directly. This well-structured healthcare system provides an appropriate setting to examine national SAP practices and identify opportunities for stewardship improvement.

1.7. Project justification and design

1.7.1. Research rationale

SSI is one of the most frequently reported and studied Healthcare-associated infections (HCAIs) worldwide. Numerous evidence-based measures are available to minimise SSI risk, among which SAP remains one of the most effective. Despite the extensive international evidence supporting SAP in reducing postoperative infections, studies consistently report inappropriate use, overuse, and poor adherence to guidelines. Inappropriate SAP prescribing not only compromises patient safety but also contributes to medication-related adverse effects, increased healthcare costs, and the growing threat of AMR at both national and global levels.

In Kuwait, data on SAP prescribing in OB/GYN surgery remains limited. Existing local studies consistently highlight poor compliance with antibiotic guidelines and rising SSI rates (Aly *et al.*, 2012; Alfouzan *et al.*, 2019). The cross-sectional national audit by Aly *et al.* (2012), which reviewed 1,528

antibiotic prescriptions across nine hospitals, found generally poor adherence to local antibiotic-policy guidelines, including inappropriate antibiotic selection and unnecessary prescribing, with only 30.4% of prescriptions fully compliant. Although the study included surgical prophylaxis as one of several indications, it was not SAP-specific and did not examine OB/GYN procedures in detail. Moreover, this study was conducted 14 years ago, making the findings outdated.

Similarly, Alfouzan *et al.* (2019) examined the rate of SSI following C-section procedures in a major maternity hospital and reported an increase from 1.7% in 2014 to 2.9% in 2016. The authors suggested that inconsistent SAP practices within the hospital may have contributed to the rise in SSI rates. However, the study did not directly assess SAP appropriateness or evaluate specific prophylaxis parameters such as timing, selection, dose, route, duration, or indication, and was limited to a single hospital. More recently, a retrospective audit investigating perioperative SAP administration reported significant delays, mainly due to logistical and communication issues between surgical and anaesthesia teams (Shinde *et al.*, 2025). Although this audit was recent and highlighted important challenges in SAP timing, it was similarly limited to a single setting and mainly focused on the timing of SAP rather than other SAP components/parameters such as antibiotic choice, duration and overall SAP appropriateness.

Collectively, these findings demonstrate an urgent need for a comprehensive assessment of SAP prescribing and their determinants in Kuwait's healthcare system. In particular, there is limited understanding of the appropriateness and quality of SAP prescribing and clinician's knowledge, attitudes, practice and behaviours influencing this practice. Addressing these gaps is essential to guide evidence-based AMS strategies. A mixed-methods approach is therefore warranted (Creswell *et al.*, 2017). The quantitative component is needed to quantify prescribing quality and identify the scale and pattern of inappropriate SAP use across hospitals, while the qualitative component provides insight into clinicians' decision-making and the organisational and contextual factors shaping their prescribing behaviour. Together, these studies will generate a comprehensive understanding of SAP practice in Kuwait and support the development of targeted, context-specific AMS interventions.

1.8. Research aims, objectives and questions

1.8.1. Research questions

1. What is the current practice of SAP and its appropriateness in terms of the key SAP parameters (indication, selection, timing, duration, route and dose) in OB/GYN surgery?
2. What is the level/extent of knowledge, attitudes, and practice of surgeons and anaesthetists regarding appropriate SAP prescribing and guideline adherence in OB/GYN surgery?
3. What are the key facilitators and barriers influencing appropriate SAP prescribing in OB/GYN surgery?

1.8.2. Research aims

The overall aim of this PhD was to evaluate the prescribing of SAP in OB/GYN surgery in Kuwait through a mixed-methods approach to inform antimicrobial stewardship strategies.

1.8.3. Objectives:

1. To evaluate current prescribing practices of SAP in OB/GYN surgery using a national point prevalence survey.
2. To determine clinician's knowledge, attitudes, and practice regarding appropriate SAP prescribing through an online questionnaire.
3. To identify the barriers and the facilitators influencing appropriate SAP prescribing, using semi-structured interviews.
4. To integrate quantitative and qualitative findings to synthesise evidence to inform AMS interventions tailored to Kuwaiti healthcare system.

1.8.4. Research design and approach

This PhD adopts an explanatory, sequential, mixed methods design, which begins with collecting and analysing quantitative data to identify the extent and scope of the issues related to SAP prescribing, and then uses qualitative data to explain or elaborate on those findings. This design provides a comprehensive understanding of the research problem (Creswell *et al.*, 2017). It is chosen for its ability to offer a holistic and contextual understanding of SAP prescribing in OB/GYN, a complex behaviour influenced by institutional, professional, and contextual factors that cannot be fully captured through a single method alone.

This research is structured in three distinct stages, each building on the previous one to examine SAP prescribing practice in OB/GYN in Kuwait (Figure 1.3). The first stage involved a national PPS to establish a benchmark of SAP utilisation patterns and appropriateness levels across hospitals in Kuwait. The quantitative results identified key issues, such as extended SAP duration and deviations from guideline recommendations.

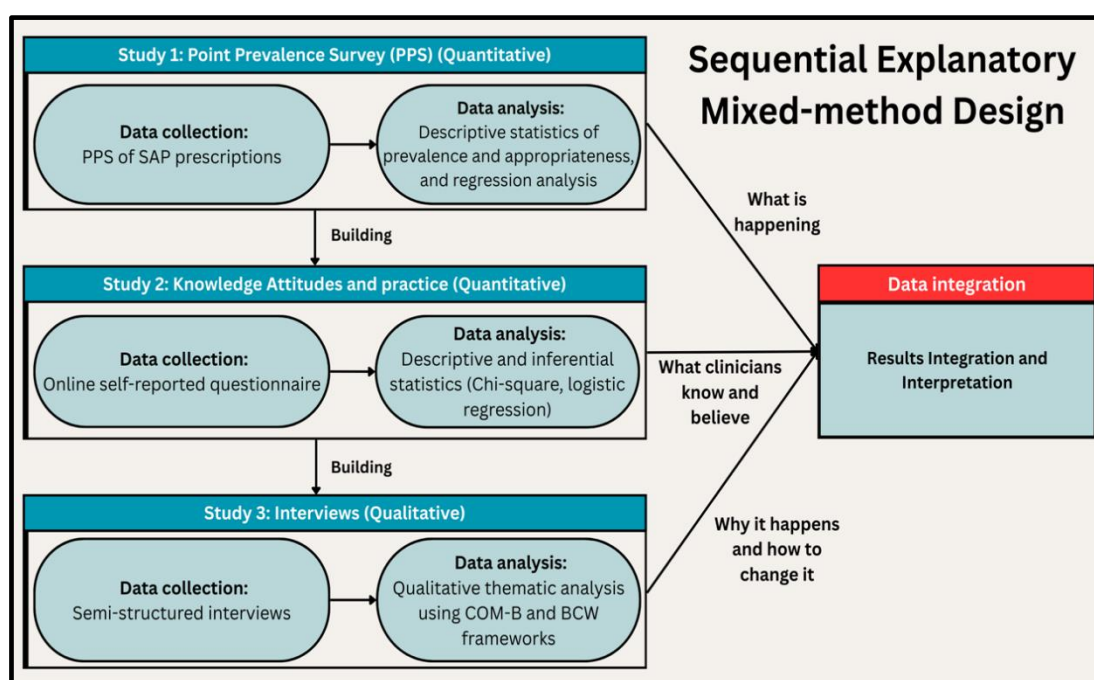


Figure 1.3: Overview of the sequential explanatory mixed-methods design.

The second stage comprised a knowledge, attitudes, and practice (KAP) survey, designed to investigate clinician's awareness of guidelines, perceptions of appropriate SAP prescribing, and the extent to which knowledge translates into daily practice. Insights from the PPS informed the development of the KAP survey tool, ensuring it addressed the identified gaps.

The final stage consisted of semi-structured qualitative interviews, which allowed an in-depth exploration of the barriers and facilitators affecting SAP prescribing behaviour. The interviews were guided by findings from both the PPS and KAP surveys, enabling participants to discuss specific challenges such as decision-making processes, resource availability, and professional hierarchies.

The advantage of using a sequential mixed methods design lies in its ability to achieve both complementarity and triangulation between quantitative and qualitative findings, providing a layered understanding of SAP prescribing behaviour in OB/GYN. The quantitative phases (PPS and KAP survey) offered breadth by determining the scale and scope of prescribing patterns and deviations from guidelines. Although these quantitative data can offer some preliminary insight into why inappropriate SAP use occurs, such explanations are often superficial because PPS data are observational and KAP responses are self-reported. The qualitative phase, therefore, adds essential depth by exploring the contextual and behavioural drivers behind the quantitative patterns.

Sequencing the studies in this way allowed each phase to inform the next, resulting in a more nuanced and methodologically robust interpretation of prescribing practice than would have been possible with a single method. This approach is particularly effective in health services and implementation research, where clinical behaviours are influenced by complex, context-

specific factors. For example, Vaughn *et al.* (2024) demonstrated how sequential mixed methods can uncover both measurable outcomes and the institutional and professional dynamics that influence AMS. In Kuwait's healthcare system, this design enhanced the practical relevance of findings and supported the development of tailored, evidence-informed AMS interventions to improve SAP utilisation.

Chapter 2. National Assessment of the Prescribing Practice of Surgical Antibiotic Prophylaxis in Obstetric and Gynaecological Surgery in Kuwait: A Point Prevalence Survey

2.1. Introduction

Surgical site infections (SSIs) remain among the most common healthcare-associated infections globally, particularly in obstetrics and gynaecology (OB/GYN) surgery, such as caesarean sections (C-sections) (Bhasin *et al.*, 2007; Charoenboon *et al.*, 2013; Monahan *et al.*, 2020; Gomaa *et al.*, 2021; World Health Organization, 2021b; Angolile *et al.*, 2023). SSIs account for 10–30% of all healthcare-associated infections worldwide (Allegranzi *et al.*, 2011; European Centre for Disease Prevention and Control, 2013; Haque *et al.*, 2018), with reported rates after OB/GYN surgery, ranging from 2.5% to 42% in low- and middle-income countries (Pathak *et al.*, 2017; Kulkarni *et al.*, 2023).

Surgical antibiotic prophylaxis (SAP), a short course of antibiotics administered before surgery, is a proven strategy that prevents nearly 50% of SSIs (Berrios-Torres *et al.*, 2017). International guidelines, including those by American College of Obstetricians and Gynecologists (ACOG) and the National Institute for Health and Care Excellence (NICE), recommend a single preoperative dose of a narrow-spectrum antibiotic (e.g., cefazolin) administered within 60 minutes before incision (Ierano *et al.*, 2017; American College of Obstetricians and Gynecologists, 2018; National Institute for Health and Care Excellence (NICE), 2019). However, despite clear recommendations, adherence to SAP guidelines, including in OB/GYN surgery, remains suboptimal in many settings, with report misuse, involving delayed administration, prolonged duration, and

inappropriate antibiotic selection (Gouvea *et al.*, 2015; Abubakar *et al.*, 2018; Alemkere, 2018; Arteaga-Livias *et al.*, 2023). Such practice increases the risk of postoperative complications and contributes to the global threat of antimicrobial resistance (AMR) (de Jonge *et al.*, 2017a; Branch-Elliman *et al.*, 2019). Monitoring and improving rational antibiotic use, including appropriate SAP, is essential to combat and reduce AMR and, ultimately, safeguard public health (Cooper *et al.*, 2020).

As discussed in Chapter 1 (Section 1.7.1), data on SAP practice in OB/GYN surgery in Kuwait are limited, with studies showing poor compliance and rising SSI rates (Aly *et al.*, 2012; Alfouzan *et al.*, 2019). Aly *et al.* (2012) found suboptimal adherence, but it was a 14-year-old, single-hospital study, limiting relevance. Alfouzan *et al.* (2019) saw SSI increase from 1.7% to 2.9% from 2014 to 2016, with inappropriate SAP prescribing as a factor. This retrospective study was also single-hospital and did not assess all SAP parameters. More recent audits (Shinde *et al.*, 2025) reported delays due to logistical issues, but they focused mainly on timing and were limited to one setting.

Together, these studies highlight the significant gap in the literature that there are no recent, nationwide assessments of SAP prescribing practices in OB/GYN surgery in Kuwait. This lack of up-to-date national data limits the understanding of the current prescribing practice of SAP and compliance levels, and future opportunities for antimicrobial stewardship interventions.

Thus, this study aims to evaluate the prescribing and appropriateness of SAP in OB/GYN surgery across Kuwait's public and private hospitals using a national point prevalence survey (PPS).

2.1.1. Research question:

What is the current prescribing practice of surgical antibiotic prophylaxis in obstetric and gynaecological surgical procedures in Kuwait?

2.1.2. Aim of this study

This study aimed to investigate the current prescribing practice of SAP in OB/GYN surgery in Kuwait. Specifically, it sought to determine SAP prevalence and assess the appropriateness of SAP prescribing across key SAP parameters, including antibiotic selection, dose, timing, duration, route of administration, and eligibility for prophylaxis (i.e., whether SAP use was clinically justified). In addition, the study aimed to identify factors associated with inappropriate SAP prescribing.

2.2. Methods

2.2.1. Study design

This study utilised a national multi-centre point prevalence survey, following the Global Point Prevalence Survey (GPPS) protocol (January 2021) and the WHO methodology for Point Prevalence Surveys on Antibiotic Use in Hospitals (version 1.1) (World Health Organization, 2018b; University of Antwerp, 2021). A PPS was selected because it is a validated and standardised approach for assessing the prevalence and appropriateness of antibiotic use. It provides a

cross-sectional “snapshot” of antibiotic prescribing practices and adherence to clinical guidelines on specific day or over a defined period (Levy Hara *et al.*, 2021). This data collection method could offer insights into the appropriateness of SAP and identify misuse and overuse and areas that require improvement. Moreover, PPSs serve as an effective tool for monitoring antimicrobial stewardship (AMS) activities and evaluating the impact of interventions aimed at optimising antibiotic use.

A PPS methodology was also necessitated by the absence of centralised, accessible datasets on medication prescribing or administration in Kuwait. Unlike healthcare systems in many high-income countries, where electronic health records or pharmacy dispensing databases enable retrospective extraction of antibiotic prescribing data, no such national or hospital-level database was available for this study. Across the participating hospitals, antibiotic prescribing was primarily documented through handwritten prescription forms and paper-based patient records, which are not linked to any electronic system or databases. Therefore, data extraction was only feasible through prospective manual data collection using PSS.

This method has been widely adopted internationally, including the WHO and the European Centre for Disease Prevention and Control (ECDC), as part of the global AMS surveillance initiatives (Zarb *et al.*, 2012; World Health Organization, 2018b; Vandael *et al.*, 2020; Levy Hara *et al.*, 2021; ECDC, 2024). Numerous international studies across Europe, the Americas, Africa,

Asia and the Middle East have successfully applied the PPS design to evaluate antibiotic prescribing practice and identify areas for improvement (Cairns *et al.*, 2018; World Health Organization, 2019b; Haseeb *et al.*, 2021; Levy Hara *et al.*, 2021; Hassan *et al.*, 2023; Schrama *et al.*, 2025).

2.2.2. Study setting and population

There are six governorates in Kuwait: Kuwait City, Hawalli, Farwaniya, Mubarak Al-Kabir, Al Ahmadi, and Al-Jahra. OB/GYN surgery are provided across all governorates through hospitals in both public and private sectors. The public sector includes one tertiary-care and four secondary-care hospitals with OB/GYN departments. Several private hospitals also offer specialised OB/GYN surgery, primarily serving patients who can afford private care.

The PPS was conducted in all OB/GYN wards of the five public hospitals, and in four major private hospitals (out of 16 in Kuwait) that were conveniently selected based on their willingness to participate and existing professional connections. These hospitals were chosen to ensure broad representation of private hospitals across different governorates.

2.2.3. Inclusion and exclusion criteria

Eligible participants were all inpatients over 18 years who were admitted before 10 AM on the day of data collection, underwent elective or emergency OB/GYN surgery (denominator), and received at least one dose of SAP for their procedure (numerator). Patients were excluded if they were one-day

surgery patients, admitted after 10 AM on the day of data collection, non-OB/GYN surgical patients, or those receiving antibiotics for therapeutic (non-prophylactic) indications.

2.2.4. Data collection

All patient-level data were collected personally by the principal investigator (F.A.) from each OB/GYN ward using a standardised data collection form adapted from the GPPS and WHO PPS data collection tools (World Health Organization, 2018b; University of Antwerp, 2021). The ward staff and clinical teams were not informed of the specific date of the survey visit in advance. Survey dates were identified by the principal investigator independently, based on weekly elective surgery schedules obtained from the head nurse during the initial hospital access arrangements, without further advance notice to ward staff. Following the GPPS protocol, each OB/GYN ward was surveyed and completed on a single day, while different wards within the same hospital were completed on either the same or different days. All wards within an individual hospital were surveyed within a consecutive four-week period (depending on hospital size) from the start date of the PPS at that hospital. The overall data collection for the entire study was conducted between 15 December 2022 and 15 March 2023 across both public and private secondary/ tertiary healthcare settings.

Following GPPS recommendations, surveys were conducted on the day after the highest volume of elective surgery, identified in consultation with the head

nurse in each of the participating hospitals using weekly elective surgery schedules. These days vary across hospitals, most commonly Sundays, Tuesdays, and Wednesdays. For consistency, all OB/GYN surgery onward will be referred as surgery.

2.2.5. Adaptation of GPPS protocol data collection

Several modifications were made to the GPPS protocol to align with the study objectives and local hospital workflow.

- **Adjusting the timing of the survey:** the data collection start time was changed from 8 AM to start at 10 AM instead to avoid overlapping with medical rounds and ensure better access to patient records and staff availability.
- **Focusing only on SAP prescribing:** the survey scope was limited to surgical inpatients receiving SAP, excluding other antibiotic indications and HCAs, which were beyond the study objective.

The data was collected using a modified hard copy tool (Appendix 2.1) adapted from both the GPPS and WHO PPS protocols (World Health Organization, 2018b; University of Antwerp, 2021). The adaptation process involved merging key elements from both instruments to suite the context of the study and reflect local practice in Kuwait. Specifically:

- SAP-related sections (e.g., indication, timing of administration, intra- and postoperative doses) were derived and expanded from the GPPS tool, which provides detailed antibiotic prescribing indicators.

- Patient demographic and clinical characteristics (e.g., comorbidities, procedure type, and wound classification) were integrated from the WHO PPS tool, which captures broader contextual and hospital-level data)
- Sections unrelated to the study focus, such as antimicrobial use for non-surgical indications and HCAs surveillance, were removed.

The final tool was piloted in one OB/GYN prior to commencing the main data collection. The pilot confirmed that the tool was feasible to complete within the survey timeframe and that all data, including the key SAP parameters (indication, antibiotic selection, dose, route, timing, and duration), could be consistently extracted from patient files. No amendments to the tool were required before the main data collection began. All hard copies were transferred into an Excel spreadsheet and then destroyed. The electronic dataset was securely uploaded and stored in PURE, the University of Strathclyde's research managing system, following the University's data retention policy. Data will be retained securely for at least 10 years.

2.2.6. Data collection tool and data source

Data on patient characteristics, surgery details, and antibiotic usage were collected from patient files, charts, clinical notes, and hospital computer systems. Hospital and ward-level data were collected from the OB/GYN head of department, ward head nurse, or nursing team.

2.2.6.1. Data collection forms

Three key forms were used during data collection:

1. **Hospital form:** Used to record hospital code, hospital type (secondary, tertiary, or private), survey start/end date, and availability of local OB/GYN surgical guidelines.
2. **Ward form:** Used to record ward code, survey date, ward speciality (obstetrics, gynaecology, or mixed), total beds in the ward, number of admitted patients, number of surgical patients and number of receiving SAP.
3. **Patient form:** This was the most detailed form and included three subsections. First, the patient data recorded survey number, patient code, admission date, date of birth, weight, comorbidities, smoking status, and antimicrobial allergies. Comorbidity was defined as the presence of one or more chronic medical conditions documented in the patient's record that could influence surgical risk or antibiotic prescribing. These included, but were not limited to, diabetes mellitus, hypertension, thyroid disorders, chronic respiratory diseases, chronic kidney disease, and cardiovascular disease. Secondly, the surgery data section recorded surgery date, type, speciality, procedure name, wound classification, and incision start/end time. Thirdly, the antibiotic subsection recorded the antibiotic name, WHO's 2019 AWaRe classification (Access, Watch, Reserve) (Table 2.1), dose, route, timing of the first dose, postoperative frequency, start/end dates, reason for

continuation, and documentation of discontinuation (including the stop date).

Table 2:1: World Health Organization classification of Access, Watch and Reserve list of antibiotics.

Category	Definition	Antibiotic examples
Access	Narrow spectrum antibiotics, fewer side effects, lower cost and lower resistance potential	Ampicillin, Cefazolin, gentamicin, metronidazole
Watch	Broader-spectrum antibiotics with higher resistance potential	Ceftriaxone, Cefuroxime
Reserve	Last resort, including new antibiotics, used for highly selected patients (life-threatening infections due to multi-drug-resistant bacteria	Cefiderocol

2.2.6.2. Surgical antibiotic prophylaxis: definition and stages of antibiotic administration

2.2.6.2.1. Definition of surgical antibiotic prophylaxis

SAP was defined as any antibiotic given within one hour before the surgery and, when indicated or re-dosing during the surgery to prevent postoperative SSIs (Berrios-Torres *et al.*, 2017; Ierano *et al.*, 2017; American College of Obstetricians and Gynecologists, 2018; National Institute for Health and Care Excellence (NICE), 2019). In obstetric practice in Kuwait, some local guidelines recommend administering the prophylactic dose after cord clamping during C-sections; therefore, intra-operative doses were also considered SAP (Appendix 2.2). Therefore, for the purpose of this study, SAP referred exclusively to preoperative and intraoperative prophylactic doses. Postoperative antibiotics were recorded separately as therapeutic or extended prophylactic use and were not classified as SAP for the purposes of prevalence or compliance assessment.

2.2.6.2.2. Stages of antibiotic administration:

To ensure a comprehensive assessment of SAP administration, antibiotics were classified based on their timing in relation to surgery.

- **Preoperative SAP** was defined as antibiotics administered before the surgical incision.
- **Intraoperative antibiotics** are those administered between the start and end of surgery.
- **Postoperative antibiotics** were defined as those administered intravenously after surgery or prescribed orally upon discharge. Any antibiotic administered after wound closure was regarded as postoperative antibiotic use, regardless of the route of administration, and was not classified as SAP.

Although SAP technically includes only preoperative administration and intraoperative re-dosing, the study also examined intraoperative and postoperative continuation. This was necessary because some local obstetric guidelines in Kuwait recommend extending prophylaxis beyond the initial dose, including routine postoperative courses. Intraoperative escalation and postoperative continuation are considered inappropriate extensions of prophylaxis and major contributors to SAP non-compliance (Ierano *et al.*, 2019a; Mwita *et al.*, 2021). International guidelines consistently recommend against routine broadening intraoperatively and against continuing prophylaxis beyond 24 hours (Scottish Intercollegiate Guidelines Network, 2014; Berrios-

Torres *et al.*, 2017; American College of Obstetricians and Gynecologists, 2018; National Institute for Health and Care Excellence (NICE), 2019).

SAP timing was verified through multiple documentation sources, including the patient file, the surgical order sheet, the anaesthesia record, and the nursing notes. If discrepancies existed or documentation was incomplete, the timing was confirmed verbally with the responsible nursing staff during data collection. If no documentation or confirmation could be obtained from any source, the case was recorded as “timing not recorded”. In such cases, antibiotic selection and route were still extracted if available.

2.2.6.2.3. Definition of Escalation of SAP

SAP escalation was defined as either the addition of a second antibiotic to extend coverage beyond that antimicrobial agent recommended for prophylaxis (e.g., adding metronidazole or aminoglycosides) or the substitution of a narrower agent with a broader-spectrum cephalosporin or β -lactam/ β -lactamase inhibitor. These adjustments were generally made intra-operatively or immediately post-operatively, often when contamination was suspected or based on the surgeon’s preference rather than a documented indication.

2.2.7. Outcome measures

2.2.7.1. SAP prevalence (Patient-level)

SAP prevalence was defined as the proportion of patients who underwent surgery and received SAP. The denominator was the total number of OB/GYN

surgical patients present on the ward at 10:00 AM, and the numerator was the number prescribed SAP (Figure 2.1).

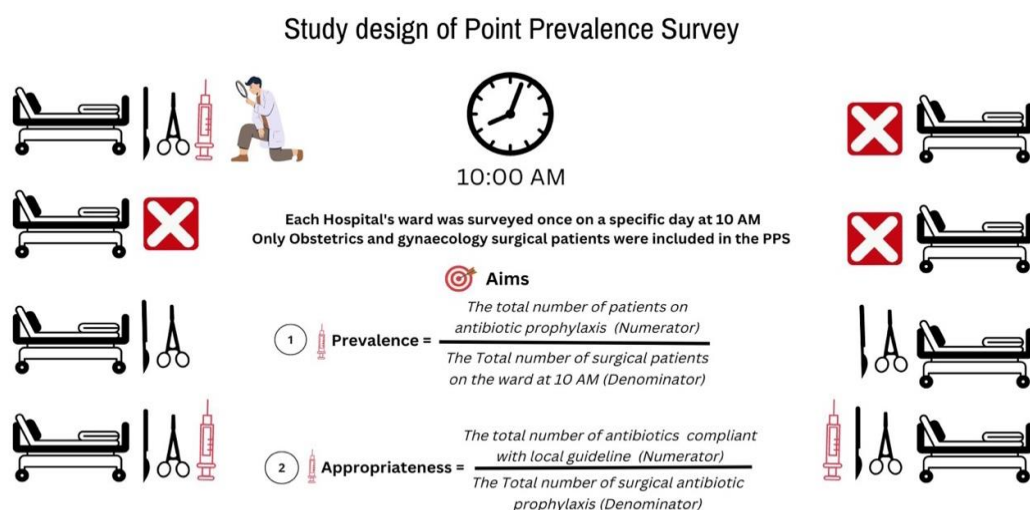


Figure 2.1: A summary of the point prevalence survey methodology and the study's objectives.

2.2.7.2. Compliance with surgical antibiotic prophylaxis guidelines

Compliance with SAP guidelines was assessed at both the patient and antibiotic prescription levels. To ensure standardised evaluation across hospitals, all SAP prescriptions were assessed against the American College of Obstetricians and Gynecologists (ACOG) guideline (2018), which served as the international reference standard (American College of Obstetricians and Gynecologists, 2018). ACOG was selected as the international benchmark because it provides comprehensive, procedure-specific recommendations for OB/GYN surgery, with clear guidance on antibiotic selection, timing, dosing, and duration. In addition, the guideline is well-suited to the Kuwaiti context,

where many clinical specialities and hospitals adopt American-based guidelines and align their practices with U.S. standards (Alhajji *et al.*, 2020).

For hospitals with local SAP guidelines, prescribing was also compared with those local hospital guidelines to identify any non-compliance. This dual assessment approach allowed identification of cases where prescribing was compliant with hospital policy but not fully aligned with ACOG recommendations, providing a comprehensive overview of SAP prescribing practices across both sectors in Kuwait (American College of Obstetricians and Gynecologists, 2018).

The compliance assessment covered each key SAP parameter, including indication, eligibility for SAP, antibiotic selection, dose, route, timing, and duration. A regimen was considered fully compliant only if all parameters met guideline recommendations.

2.2.7.2.1. Patient-level compliance

At the patient level, the entire SAP regimen (initial pre-/intra-operative dose and any postoperative continuation prescribed) was assessed against local and ACOG guidelines (Figure 2.2):

1) ACOG compliance:

The regimen was considered compliant only if it fully adhered to ACOG (2018) recommendations across each key parameter, including indication, eligibility

for SAP, antibiotic selection, dose, route, timing, and duration (American College of Obstetricians and Gynecologists, 2018).

2) Local guidelines compliance (where applicable):

For hospitals with their own SAP guidelines, the same regimen was also assessed against local guidelines to determine adherence.

For both assessments, the denominator was the total number of patients who were prescribed SAP, and the numerator was the number considered compliant. In addition to overall compliance, each SAP parameter was also assessed individually at the patient level.

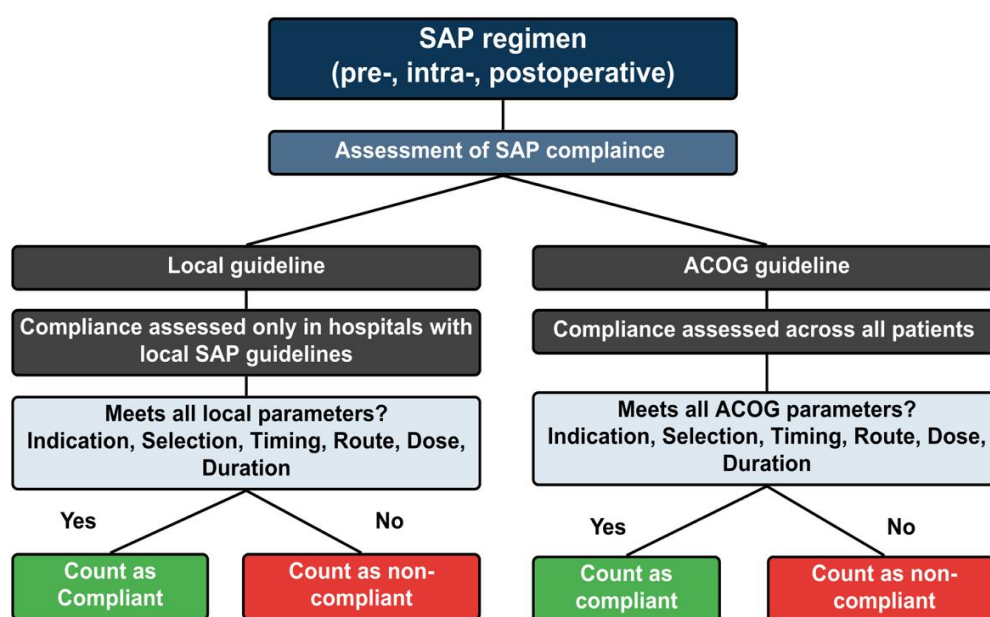


Figure 2.2: Summary of the process used to assess compliance with surgical antibiotic prophylaxis at the patient level. Regimens were evaluated independently against local hospital guidelines (where available) and the ACOG (2018) guideline.

2.2.7.2.2. Medication-level compliance

Each antibiotic prescribed at each stage was assessed individually across all key parameters against the two guidelines:

1) ACOG guidelines compliance:

Each antibiotic was evaluated against ACOG (2018) guideline recommendations across all key parameters (indication, selection, dose, route, timing, and duration) (American College of Obstetricians and Gynecologists, 2018).

2) Local hospital guidelines:

In hospitals with their own SAP guidelines, each antibiotic was also assessed against the corresponding local protocol to determine adherence to hospital policy.

For both assessments, the denominator was the total number of SAP antibiotics prescribed, and the numerator was the number of antibiotics considered compliant. Each SAP parameter was also assessed individually at the medication level.

2.2.7.2.3. Key surgical antibiotic prophylaxis parameters

A prescription/regimen was deemed overall compliant only if it fully adhered to all six key parameters; otherwise, it was considered non-compliant. These parameters were applied consistently at both the patient level (for the entire regimen) and the medication level (for each antibiotic). The corresponding local and ACOG guideline recommendations for each parameter are provided in (Appendix 2.2).

1. Indication for SAP

Indication compliance was determined by whether SAP was prescribed appropriately for the type of surgical procedure. Compliance was defined as prescribing SAP only for procedures where prophylaxis was indicated (e.g., clean surgery with implants, clean-contaminated, contaminated, or dirty procedures). Non-compliance was defined as prescribing SAP for procedures where prophylaxis was not recommended, such as clean procedures without risk factors (American College of Obstetricians and Gynecologists, 2018; Centers for Disease Control and Prevention, 2025). See Table 2.2.

Table 2:2: Obstetric and gynaecological procedures requiring surgical antibiotic prophylaxis according to the American College of Obstetricians and Gynecologists (ACOG) guideline (2018) and their corresponding CDC surgical wound classification

Procedure	ACOG SAP Required?	CDC Surgical Wound Classification
Caesarean section (elective or emergency)	Yes	Clean–contaminated
Abdominal hysterectomy	Yes	Clean–contaminated
Vaginal hysterectomy	Yes	Clean–contaminated
Robotic/Laparoscopic hysterectomy	Yes	Clean–contaminated
Major open gynaecologic surgery (with uterine/vaginal entry)	Yes	Clean–contaminated
Evacuation for uncomplicated miscarriage (D&C)	No routine SAP	Clean or Clean–contaminated
Diagnostic hysteroscopy	No	Clean–contaminated
Operative hysteroscopy	No	Clean–contaminated
Endometrial biopsy	No	Clean–contaminated
IUD insertion	No	Clean–contaminated
Diagnostic laparoscopy without genital tract entry	No	Clean
Laparoscopic ovarian cystectomy (clean case)	No	Clean
Tubal ligation (lap/open)	No	Clean
Cervical cerclage (elective)	No	Clean–contaminated

2. Selection of antibiotic prophylaxis

Antibiotic selection was considered compliant if the chosen antibiotic matched the recommendations of the local hospital guidelines or the ACOG guideline for that specific surgical procedure.

3. Dosing of SAP

Dose was considered compliant if the administered antibiotic dose adhered to local or ACOG guideline recommendations for the specific antibiotic and procedure.

4. Route of SAP administration

The intravenous route was considered compliant unless oral administration was explicitly supported by a local protocol (e.g., Hospital C, Appendix 2.2).

5. Timing of SAP

SAP was compliant when administered within 60 minutes before incision, or post-cord clamping for C-sections if stated by local guidelines. SAP was considered non-compliant if administered more than 60 minutes before surgery (except for vancomycin or fluoroquinolones) or postoperatively, contrary to guidelines recommendations.

6. Duration of SAP

SAP duration was considered compliant when limited to a single dose or ≤ 24 hours (with appropriate justification documented). Longer postoperative courses recommended by some local guidelines were assessed only for local guideline compliance and were considered non-compliant with ACOG (e.g., 48-72 h continuation or 5-day oral discharge prescriptions).

2.2.7.3. Secondary outcome measures

In addition to the primary outcomes, the study assessed secondary outcomes, including identification of the most commonly prescribed antibiotics for SAP, and their classification according to the WHO's 2019 AWaRe classification. Other quality indicators were examined, including post-operative SAP documentation, including rationale for prolonged use, start and stop dates.

2.2.8. Statistical analysis

Data were processed in Microsoft Excel® and analysed using IBM SPSS Statistics version 28.0. Descriptive statistics were used to summarise study variables. Continuous variables: summarised as mean $\pm$ SD or median (interquartile range [IQR]) depending on their distribution. Normality was assessed using the Shapiro-Wilk test and histograms. Categorical variables were summarised as frequencies and percentages.

2.2.8.1. SAP duration analysis

Data on SAP duration were extracted from post-operative surgical or medical records and reflected either the actual or intended duration as documented by the prescriber. Duration was analysed both as a continuous variable (median [IQR], in days of therapy) and categorically (single-dose SAP, multiple doses within 24 hours, and multiple doses exceeding 24 hours based on the GPPS). Visual and statistical comparisons of SAP duration across hospitals, surgical characteristics, and patient characteristics were performed using boxplots to explore potential variations and identify patterns of prolonged prophylaxis.

2.2.8.2. Factors associated with SAP non-compliance (patient-level analysis).

The analysis was conducted in two stages. First, univariate analyses were performed to explore potential associations between the dependent variable, overall non-compliance (compliant vs non-compliant) and a set of independent variables. These independent variables included: hospital sector (public/private), ward type (postnatal/gynaecology/mixed), availability of local SAP guidelines (yes/no), surgical classification (elective/emergency), procedure type, wound class, nationality (Kuwaiti/non-Kuwaiti), and comorbidity status (present/absent). Associations for categorical variables were examined using the Chi-square or Fisher's exact test, as appropriate.

For continuous independent variables (age, weight, and procedure duration) comparisons were made between compliant and non-compliant SAP groups using the Mann-Whitney U test, as these variables were non-normally distributed according to the Shapiro-Wilk test.

After completing the univariate analyses, the factors independently associated with overall SAP compliance (compliant vs non-compliant) were further assessed using a multilevel logistic regression model, with hospital ID included as a random intercept to account for the hierarchical data structure and potential clustering of prescribing practices within hospitals. This model was chosen because patients were clustered and nested within hospitals, where prescribing behaviours were expected to vary.

The dependent variable represented the overall non-compliance of SAP prescribing at the patient level, rather than individual parameters, to capture the overall quality of SAP prescribing practice. The independent variables inserted in the model included institutional and clinical characteristics (hospital type, availability of local SAP guidelines, ward speciality, surgical classification, procedure type, and wound class), as well as patient-related characteristics, specifically age, weight, nationality (Kuwaiti/non-Kuwaiti), and comorbidity status (present/absent). These variables were selected based on prior literature identifying institutional, surgical, and patient-related factors influencing SAP adherence (Segala *et al.*, 2020; Hassan *et al.*, 2021; Pereira *et al.*, 2024). Results were reported as odds ratios (OR) with 95% confidence intervals (CI). A p-value <0.05 was considered statistically significant.

2.2.9. Ethical approval

Ethical approval was obtained from the Ministry of Health of Kuwait's Ethical Committee (Appendix 2.3) and endorsed by the SIPBS Ethical Committee. Following approval, OB/GYN department heads, public hospital nursing staff, and private hospital chief medical directors were informed about the study. Each hospital received a hard or soft copy of the protocol and the ethical approval documents.

2.3. Results

2.3.1. Hospital characteristics

The study was conducted across nine hospitals: five public (including one tertiary and four secondary hospitals) and four private hospitals (Table 2.1). A

total of 45 wards were surveyed, with 28 in public hospitals and 17 in private hospitals. Three hospitals (33.3%) had no local guidelines, three (33.3%) had full local guidelines covering both OB/GYN procedures, and the remaining three (33.3%) had partial guidelines limited to obstetric procedures (i.e., C-sections) (Table 2.3).

Table 2:3: Total bed capacity, number of admitted patients, and availability of local surgical antibiotic prophylaxis guidelines among the nine participated hospitals.

Hospital	Total number of beds in OB/GYN wards	Total number of admitted patients to the study	SAP Guidelines availability
A (Public)	122	73	Yes - Full
B (Public)	180	120	Yes - Partial
C (Public)	108	84	Yes - Partial
D (Public)	144	75	Yes - Partial
E (Public)	82	60	No
F (Private)	49	46	Yes - Full
G (Private)	54	38	No
H (Private)	66	48	No
I (Private)	68	46	Yes - Full
Total	873	590	6/9 hospitals with SAP guidelines

2.3.2. Patient characteristics

Of the 590 OB/GYN patients admitted, 246 had undergone OB/GYN surgical procedures. Eight patients were excluded as they had been readmitted for SSI treatment, leaving 238 patients eligible for inclusion (Figure 2.3). Most patients (157/238, 66.0%) were from public hospitals, while private hospitals admitted fewer patients (81/238, 34.0%) (Table 2.4). Overall, patients were young adults with a median age of 32.7 years (IQR 28.7-37.2). Just over half were Kuwaiti nationals (128/238, 53.8%). Obstetric surgery was the dominant speciality

(190/238, 79.8%), and C-section was the most frequently performed procedure (183/238, 76.9%). Most operations were elective (125/238, 52.5%). Regarding local SAP guidelines, nearly half of the cases (115/238, 48.3%) were managed in hospitals with partial local guidelines, while 73/238 (30.7%) were in hospitals with complete guidelines, and 50/238 (21.0%) were in hospitals without guidelines.

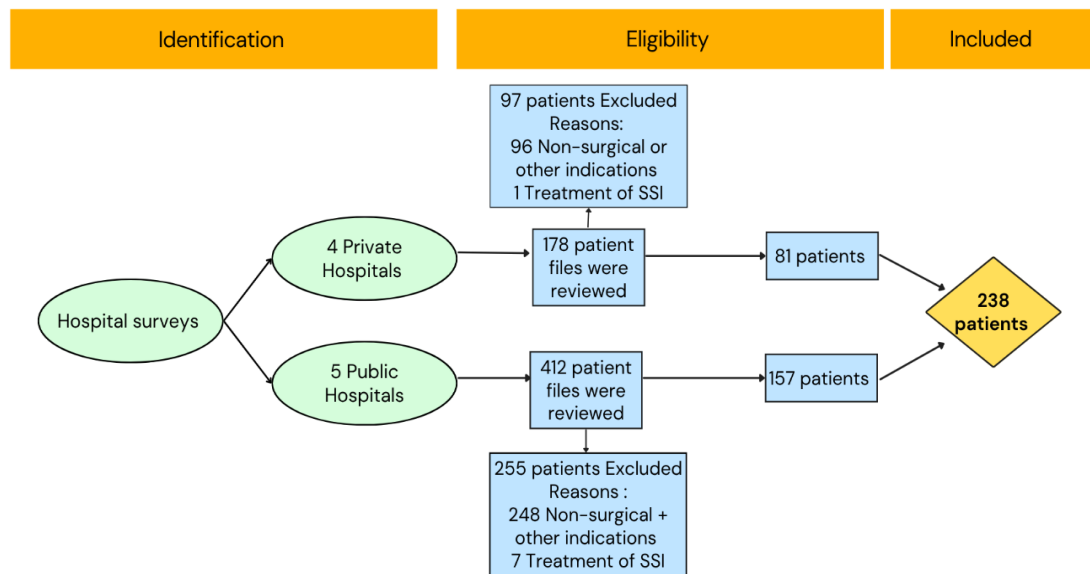


Figure 2.3: Patient inclusion flow chart

Table 2:4: Demographic and surgical characteristics of patients (n=238)

Variable	Frequency (%)
Age (median, IQR)	32.7 (28.7 – 37.2)
Nationality	
Kuwaiti	128 (53.8)
non-Kuwaiti	110 (46.2)
Overall co-morbidity	
Yes	115 (48.3)
No	123 (51.7)
Antimicrobial allergy	
Yes	13 (5.5)
No	225 (95.5)
Hospital type	
Public	157 (66.0)
Private	81 (34.0)
Surgical speciality	
Obstetrics	190 (79.8)
Gynaecology	48 (20.2)
Type of Surgery	
C-section	183 (76.9)
Hysterectomy	7 (2.9)
Dilatation and Curettage (D&C)	19 (8.0)
Other	29 (12.2)
Surgery classification	
Emergency	113 (47.5)
Elective	125 (52.5)
Wound classification	
Clean	23 (9.7)
Clean-contaminated	212 (89.1)
Dirty	3 (1.3)
Ward Type	
Post-natal	113 (47.5)
Gynaecology	21 (8.8)
Mixed	104 (43.7)
Local guideline availability	
Partial	115 (48.3)
Complete	73 (30.7)
Not available	50 (21.0)

2.3.3. Patient-level outcomes

2.3.3.1. Prevalence of surgical antimicrobial prophylaxis

Among the 238 surgical patients, 233 (97.9%) received at least one SAP antibiotic at some stage of the surgical process (pre-, intra- or postoperative). Of all surgical patients, 215/238 (90.3%) were eligible for SAP based on guidelines indications, while 23/238 (9.7%) were not. Among SAP-eligible patients, 213/215 (99.1%) received at least one antibiotic at some stage of the surgical process (pre-, intra-, or postoperatively), with 180/213 (84.5%) receiving them pre- or intra-operatively. Of these, 125/180 (69.4%) were administered preoperatively and 55/180 (30.6%) intraoperatively, see section 2.3.3.2 for a detailed timing analysis. Among patients not eligible for SAP, 20/23 (87.0%) still received antibiotics at some stage of the surgical process. Of these, 10/20 (50.0%) received them preoperatively, while the remaining 10/20 (50.0%) received them postoperatively (Figure 2.4).

A stratified analysis of pre-/intra- SAP prevalence only and overall antibiotic use by hospital type, wound classification, ward type, procedure, surgical classification, and guideline availability is presented in Table 2.5. Univariate analysis showed that the prevalence of pre-/intra- SAP varied significantly across hospitals and surgical characteristics. Pre-/intra- SAP use was significantly higher in private hospitals, clean-contaminated wounds, post-natal and mixed wards, and for C-section procedures (all $p < 0.001$), but did not differ between surgical classification (elective vs emergency, $p = 0.58$).

This univariate analysis reflects descriptive associations rather than independent predictors of SAP prevalence.

Table 2:5: Univariate analysis of surgical antibiotic prophylaxis and any antibiotic use by patients, surgery, and hospital characteristics (n = 233)

Variable	*Any antibiotic use (Pre-, Intra- and Post-op) (n =233) n (%)	Pre- / Intra- operative SAP use (n = 190) n (%)	p- value
Hospital type			
Private (n=81)	80 (98.8)	75 (92.6)	<0.001
Public (n=157)	153 (97.5)	115 (73.2)	
Wound classification			
Clean (n=23)	20 (87.0)	10 (43.5)	<0.001
Clean-contaminated (n=212)	211 (99.5)	179 (84.4)	
Dirty (n=3)	2 (66.7)	1 (33.3)	
Ward type			
Gynaecology (n=21)	17 (81.0)	8 (38.1)	<0.001
Mixed (n=104)	103 (99.0)	88 (84.6)	
Post-natal (n=113)	113 (100)	94 (83.2)	
Type of surgery			
C-section (n=183)	182 (99.5)	157 (85.8)	<0.001
D&C (n=19)	17 (89.5)	10 (52.6)	
Hysterectomy (n=7)	7 (100)	7 (100)	
Other (n=29)	27 (93.1)	16 (55.2)	
Surgery classification			
Elective (n=125)	121 (96.8)	102 (81.6)	0.58
Emergency (n=113)	112 (99.1)	88 (77.9)	
Presence of local guidelines			
Complete (n=73)	73 (100)	66 (90.4)	0.009
Partial (n=115)	114 (99.1)	83 (72.2)	
Not available (n=50)	46 (92.0)	41 (82.0)	

***Pre-/intra-operative SAP use refers to antibiotics administered within 60 minutes before incision or during surgery. *Any antibiotic use includes all antibiotics administered pre-, intra-, or post-operatively. Univariate statistical testing was performed for pre-/intra-operative SAP use only. The “any*

antibiotic use” column is descriptive and was not analysed statistically. Abbreviations: SAP = Surgical Antibiotic Prophylaxis; n = number of patients.

2.3.3.2. Timing of initial surgical antibiotic prophylaxis administration

Out of the 233 surgical patients who received antibiotics, 190 (81.5%) were given prophylaxis before or during surgery, while 43 (18.5%) received the initial antibiotics only after surgery (Figure 2.4).

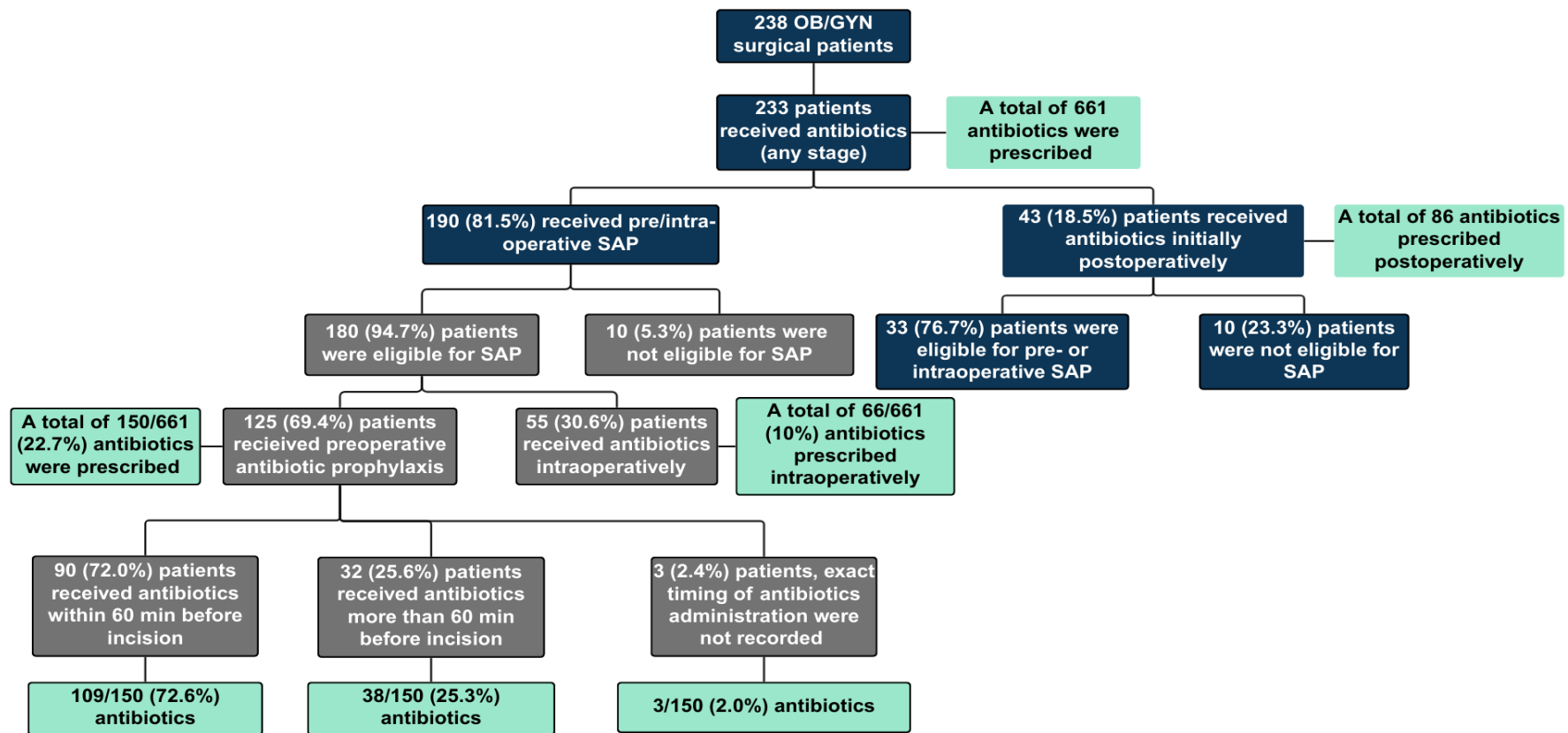


Figure 2.4: Exact timing of antibiotics prescribed for patients pre, intra and post-surgery, with the total number of antibiotics prescribed at each stage.

Only 113/190 (59.5%) preoperative SAP orders were recorded in the patient file by the surgeon; the rest were extracted from either the nurse's note or the anaesthetic note, which were either pre- or intraoperative. A stratified analysis of SAP timing, both pre- and intraoperative, is presented in Table 2.6 for the 190 patients (regardless of SAP eligibility).

Table 2:6: Timing of surgical antimicrobial prophylaxis by patient and hospital characteristics (N=190)

Variable	Within 1h n (%)	>1h before n (%)	Intra-op n (%)	Not recorded* n (%)
Hospital type				
Private (n=75)	34 (45.3)	23 (30.7)	18 (24.0)	0 (0.0)
Public (n=115)	64 (55.7)	11 (9.6)	37 (32.2)	3 (2.6)
Surgery classification				
Elective (n=102)	60 (58.8)	11 (10.8)	29 (28.4)	2 (2.0)
Emergency (n=88)	38 (43.2)	23 (26.1)	26 (29.5)	1 (1.1)
Type of surgery				
C-section (n=157)	69 (44.0)	31 (19.7)	54 (34.4)	3 (1.9)
D&C (n=10)	9 (90.0)	1 (10.0)	0 (0.0)	0 (0.0)
Hysterectomy (n=7)	7 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)
Other (n=16)	13 (81.3)	2 (12.5)	1 (6.2)	0 (0.0)
Ward type				
Gynaecology (n=8)	7 (87.5)	0 (0.0)	1 (12.5)	0 (0.0)
Mixed (n=88)	43 (48.9)	25 (28.4)	20 (22.7)	0 (0.0)
Post-natal (n=94)	48 (51.1)	9 (9.6)	34 (36.2)	3 (3.2)
Wound classification				
Clean (n=10)	8 (80)	2 (20)	0 (0)	0 (0)
Clean-contaminated (n=179)	89 (49.7)	32 (17.9)	55 (30.7)	3 (1.7)
Dirty (n=1)	1 (100)	0 (0)	0 (0)	0 (0)
Presence of local guidelines				
Complete guideline (n=66)	32 (48.5)	12 (18.2)	19 (28.8)	3 (4.5)
Partial (n=83)	45 (54.2)	11 (13.3)	27 (32.5)	0 (0.0)
Not available (n=41)	21 (51.3)	11 (26.7)	9 (22.0)	0 (0.0)

**Not recorded: indicates cases where antibiotic administration was documented but the exact time of administration was missing across all available data sources (surgical order, anaesthetic record, and nursing notes).*

2.3.3.3. Initial antibiotic selection and escalation

Most patients (165/190, 86.8%) received a single antibiotic for initial prophylaxis, while 24/190 (12.6%) received two antibiotics, and one patient (0.5%) received three antibiotics. The median number of antibiotics per patient was one (IQR: 1-1). A total of 216 intravenous (IV) antibiotics were administered to patients as SAP (pre- or intraoperative), regardless of SAP eligibility status. Of these, 204/216 (94.4%) were prescribed to patients who were eligible for SAP.

At the antibiotic class level, cephalosporins were the predominant, accounting for three-quarters of all SAP prescriptions (160/216, 74.1%) (Table 2.7). Among these, second-generation cephalosporins (91/160, 56.9%) were the most frequently prescribed, followed by third-generation agents (52/160, 32.5%), while first-generation cephalosporins were rarely prescribed (17/160, 10.6%).

Table 2:7: Class of initial antibiotics prescribed for surgical antimicrobial prophylaxis (N=216)

Antibiotic Class	Pre-op n (%)	Intra-op n (%)	Total n (%)
Second-generation cephalosporins	62 (41.3)	29 (44.0)	91(42.1)
Third-generation cephalosporins	43 (28.7)	9 (13.6)	52 (24.1)
First-generation cephalosporins	9 (6.0)	8 (12.1)	17 (7.9)
Imidazoles	11 (7.3)	8 (12.1)	19 (8.8)
β-lactam/β-lactamase inhibitors	13 (8.7)	4 (6.1)	17 (7.9)
Anti-pseudomonal β-lactam combinations	5 (3.3)	5 (7.6)	10 (4.6)
Penicillins	3 (2.0)	1 (1.5)	4 (1.9)
Carbapenems	2 (1.3)	1 (1.5)	2 (0.9)
Aminoglycosides	1 (0.7)	1 (1.5)	2 (0.9)
Lincosamides	1 (0.7)	0 (0.0)	1 (0.5)
Total	150 (100)	66 (100)	216 (100)

At the agent level, cefuroxime was the most frequently prescribed antibiotic (91/216, 42.3%), followed by ceftriaxone (52/216, 24.2%) (Table 2.8).

Table 2:8: Initial surgical antimicrobial prophylaxis prescribed pre- and intraoperatively

Antibiotic name	Pre-op n (%)	Intra-op n (%)	Total n (%)
Cefuroxime	62 (41.3)	29 (44.0)	91 (42.1)
Ceftriaxone	43 (28.7)	9 (13.6)	52 (24.1)
Metronidazole	11 (7.3)	8 (12.1)	19 (8.8)
Amoxicillin/clavulanic acid	13 (8.7)	4 (6.1)	17 (7.9)
Cefazolin	9 (6.0)	8 (12.1)	17 (7.9)
Piperacillin-tazobactam	5 (3.3)	5 (7.6)	10 (4.6)
Ampicillin	3 (2.0)	1 (1.5)	4 (1.9)
Gentamicin	1 (0.7)	1 (1.5)	2 (0.9)
Meropenem	2 (1.3)	1 (1.5)	2 (0.9)
Clindamycin	1 (0.7)	0 (0.0)	1 (0.5)
Total	150 (100)	66 (100)	216 (100)

In public hospitals, the most frequently prescribed antibiotics for pre- or intraoperative SAP were cefuroxime (83/122, 68.0%) and cefazolin (17/122, 13.9%). In contrast, private hospitals, more commonly prescribed ceftriaxone (38/94, 40.4%) and Amoxicillin/clavulanic acid (17/94, 18.1%), Figure 2.6.

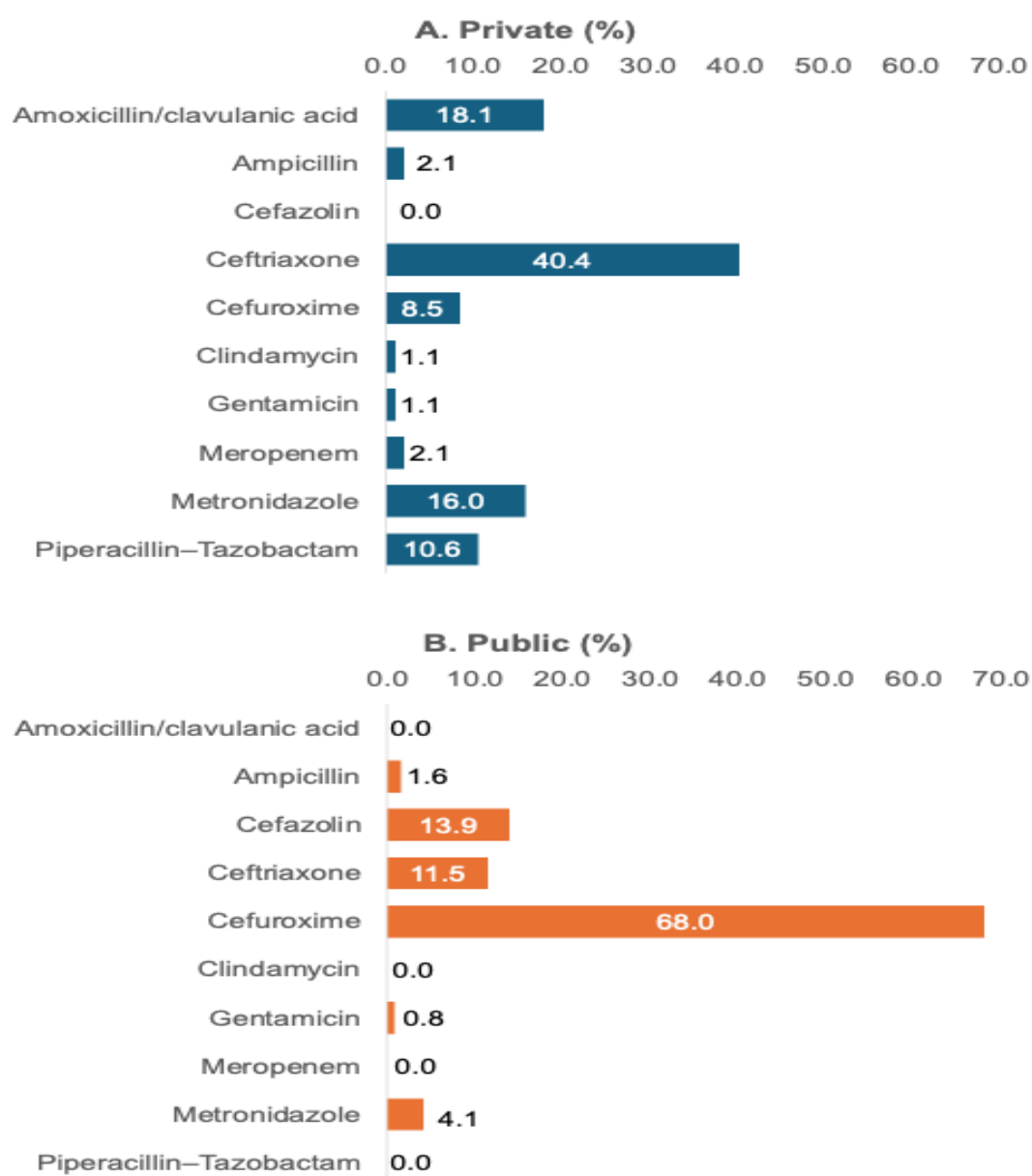


Figure 2.5: Comparison of pre-/intraoperative antibiotic agents prescribed in private (Panel A) and public (Panel B) hospitals.

2.3.3.4. Antibiotic prescribing patterns pre-, intra-, and postoperatively

2.3.3.4.1. Overall patterns by surgery stage and hospital sector

Among the 233 patients who received antibiotics at any stage, prescribing patterns varied across surgical stages (Table 2.9). Nearly half of the patients

(113/233, 48.5%) received both pre- and postoperative antibiotics. This pattern was more frequent in private hospitals (48/80, 60.0%) than in public hospitals (65/153, 42.5%). In contrast, postoperative-only prescribing was considerably more common in public hospitals (38/153, 24.8%) compared with private hospitals (5/80, 6.3%).

Table 2:9: Patterns of antibiotic prescribing by surgical stage and hospital sector of total patients (n=233)

Stage of antibiotic administration	Public (n=153) (%)	Private (n=80) (%)	Total (N=233)
Preoperative only	13 (8.5%)	4 (5.0%)	17 (7.3%)
Intraoperative only	6 (3.9%)	0 (0.0%)	6 (2.6%)
Postoperative only	38 (24.8%)	5 (6.3%)	43 (18.5%)
Pre- and postoperative	65 (42.5%)	48 (60.0%)	113 (48.5%)
Intra- and postoperative	31 (20.3%)	18 (22.5%)	49 (21.0%)
Pre-, intra- and postoperative	0 (0.0%)	5 (6.3%)	5 (2.1%)

Of the SAP eligible cases (n = 213), half of them received both pre- and post-operative antibiotics (107/213, 50.2%), followed by intra- and postoperative (49/213, 23.0%) (Table 2.10).

Table 2:10: Pattern of antibiotics prescribing among patients eligible for surgical antibiotic prophylaxis (n=213)

Stage of antibiotic administration	Number of patients (n) (%)
Pre-operative only	13 (6.1)
Intra-operative only	6 (2.8)
Post-operative only	33 (15.5)
Pre- and post-operative	107 (50.2)
Intra- and post-operative	49 (23.0)
Pre-, intra- and post-operative	5 (2.3)

2.3.3.4.2. Postoperative therapy patterns and hospital sector differences

Postoperative antibiotics were prescribed for 210/233 (90.1%) patients overall. Most public hospital patients (113/134, 84.3%) received IV therapy only, while the majority of private hospital patients (62/76, 81.6%) received both IV and oral antibiotics at discharge. Postoperative oral antibiotic prescribing was more common in private than in public hospitals (Table 2.11).

Table 2:11: Route of postoperative antibiotic prescribing by hospital sector (n = 210)

Postoperative antibiotic route	Public (n=134)	Private (n=76)	Total (N=210)
Intravenous (IV) only	113 (84.3%)	2 (2.6%)	115 (54.8%)
IV + Oral (on discharge)	15 (11.2%)	62 (81.6%)	77 (36.7%)
Oral (on discharge) only	6 (4.5%)	12 (15.8%)	18 (8.6%)

When analysed by SAP eligible who received postoperative antibiotics, the route of administration postoperatively showed similar patterns (Table 2.12).

Table 2:12: Route of postoperative antibiotic prescribing among prophylaxis-eligible patients (n = 194)

Postoperative antibiotic route	Number patients (n) (%)
Intravenous (IV) only	108 (55.7)
IV + Oral (on discharge)	73 (37.6)
Oral (on discharge) only	13 (6.7)

Overall, a total of 445 postoperative antibiotics were prescribed to the 210 patients; 341 (76.6%) were prescribed IV, and 104 (23.4%) were prescribed orally upon discharge. Public hospitals accounted for 270/445 (60.7%) prescriptions, and private hospitals for 175/445 (39.3%).

At the class level, cephalosporins remained dominant, with second-generation (93/445, 20.9%) and third-generation cephalosporins (120/445, 26.9%) together accounting for nearly half of all postoperative prescriptions (Table 2.13).

Table 2:13: Classes of antibiotics prescribed postoperatively across all hospitals (n = 445)

Antibiotic class	Post-op n (%)
Imidazoles (e.g. metronidazole)	149 (33.4)
Third-generation cephalosporins	120 (26.9)
Second-generation cephalosporins	93 (20.9)
β -lactam/ β -lactamase inhibitors	43 (9.6)
Anti-pseudomonal β -lactam combinations	13 (2.9)
Tetracyclines	10 (2.2)
Aminoglycosides	8 (1.8)
First-generation cephalosporins	6 (1.3)
Lincosamides	2 (0.4)
Carbapenems	2 (0.4)

At the agent level for postoperative prescribing, metronidazole was the most commonly prescribed antibiotic (149/445, 33.4%), followed by cefuroxime (93/445, 20.9%) and ceftriaxone (88/445, 19.7%) (Table 2.14). Postoperative prescribing differed between private and public hospitals (Figure 2.7).

Table 2:14: Postoperative antibiotic agents prescribed across all participating hospitals (n = 445)

Antibiotic name	n (%) of total
Metronidazole	149 (33.4)
Ceftriaxone	88 (19.7)
Cefuroxime	93 (20.9)
Amoxicillin/clavulanic acid	43 (9.6)
Cefpodoxime-proxetil	23 (5.2)
Cefazolin	6 (1.3)
Cefixime	9 (2.0)
Piperacillin–tazobactam	13 (2.9)
Doxycycline	10 (2.2)
Gentamicin	8 (1.8)
Meropenem	2 (0.4)
Clindamycin	2 (0.4)

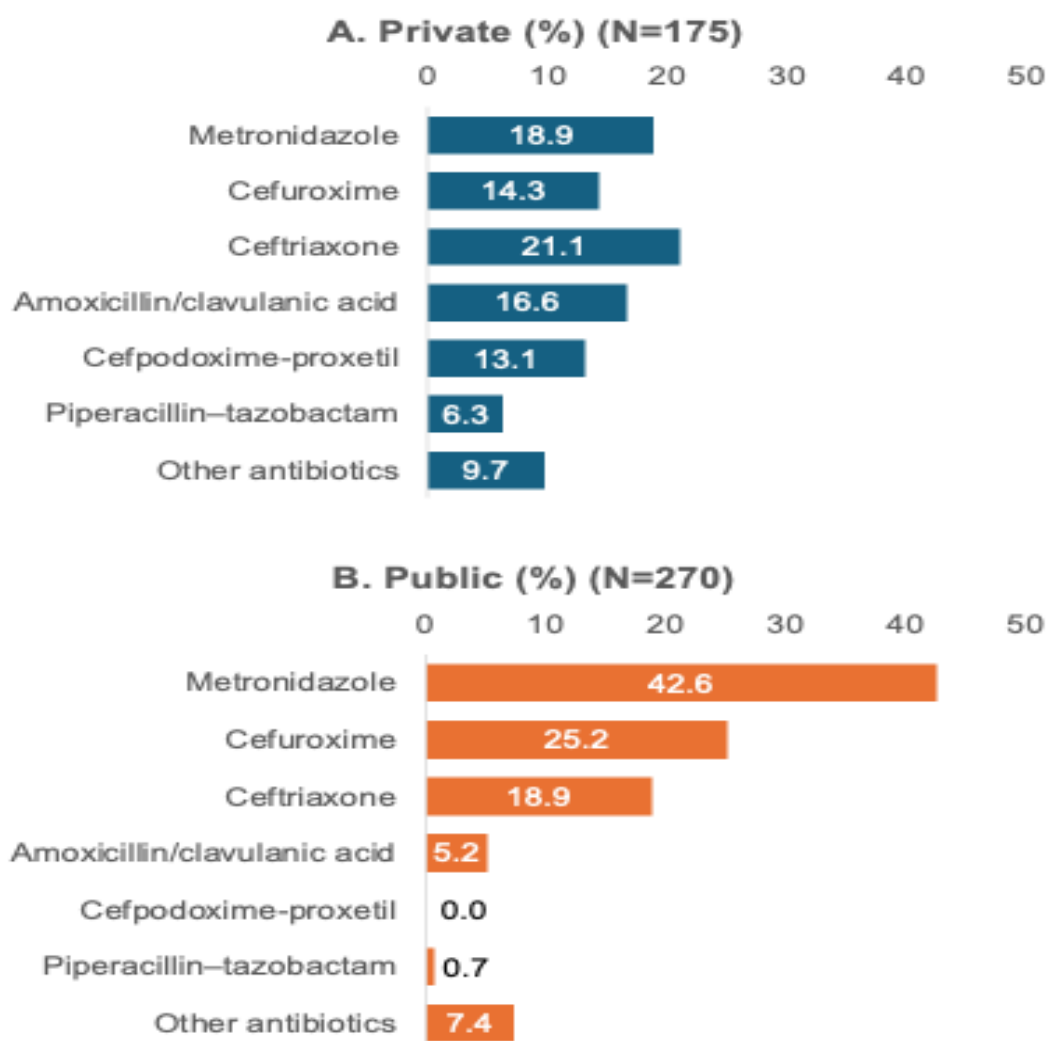


Figure 2.6: Top postoperative antibiotics used in private (Panel A) and public (Panel B) hospitals. (Other antibiotics: include cefixime, cefazolin, doxycycline, gentamicin, clindamycin, meropenem).

A total of 192 inpatients received IV postoperative antibiotic regimens following SAP across both sectors, with 128 (66.7%) from public hospitals, representing 128/153 (83.6% of the total patients within that sector) and 64/80 (80.0%) of the private sector. Combination therapy was the predominant prescribing pattern across both sectors (Table 2.15). In public hospitals, the most common combinations were cefuroxime and metronidazole (48/128, 37.5%) and

ceftriaxone and metronidazole (47/128, 36.7%). In contrast, private hospitals most frequently prescribed ceftriaxone with metronidazole (20/64, 31.3%) and amoxicillin/clavulanic acid monotherapy (8/64, 12.5%). The postoperative use of carbapenems (meropenem) was limited in private hospitals (2/64, 3.1%).

Table 2:15: Common postoperative inpatient regimens prescribed following surgical antibiotic prophylaxis by hospital sector (n = 192)

Regimen	Public hospitals (n = 128)	Private hospitals (n = 64)	Total (N = 192)
Ceftriaxone + Metronidazole	47 (36.7%)	20 (31.3%)	67 (34.9%)
Cefuroxime + Metronidazole	48 (37.5%)	1 (1.6%)	50 (26.0%)
Cefuroxime	13 (10.2%)	3 (4.7%)	16 (8.3%)
Ceftriaxone	4 (3.1%)	14 (21.9%)	18 (9.4%)
Amoxicillin/Clavulanic acid ± Metronidazole	2 (1.6%)	10 (15.6%)	12 (6.3%)
Piperacillin–Tazobactam ± Metronidazole	2 (1.6%)	11 (17.2%)	13 (6.8%)
Triple combinations (Cephalosporin + Metronidazole + Gentamicin)	7 (5.5%)	2 (3.1%)	9 (4.7%)
Others (e.g., Clindamycin-based, Meropenem)	5 (3.9%)	3 (4.7%)	8 (4.2%)

On discharge, the most frequently prescribed class of antibiotics as oral antibiotic therapy was β -lactam/ β -lactamase inhibitors (33/104, 31.7%) (Table 2.16).

Table 2:16: Classes of Oral antibiotics prescribed on discharge following surgical antibiotic prophylaxis (n= 104)

Antibiotic class	Oral n (%)
β -lactam/ β -lactamase inhibitors	33 (31.7)
Third-generation cephalosporins	32 (30.8)
Second-generation cephalosporins	22 (21.2)
Tetracyclines	9 (8.7)
Imidazole	8 (7.7)

Most oral antibiotics were prescribed in private hospitals (77/104, 74.4%), where oral cefpodoxime-proxetil (a third-generation cephalosporin) was the most commonly prescribed (23/77, 29.9%), followed by cefuroxime (a second-generation cephalosporin) (21/77, 27.3%). In contrast, amoxicillin/clavulanic acid (14/27, 51.9%) was the most frequently prescribed medication in public hospitals (Table 2.17).

Table 2:17: Oral antibiotics prescribed on discharge following surgical antibiotic prophylaxis by the hospital sector (n = 104)

Antibiotic agent	Public hospitals (n=27)	Private hospitals (n=77)	Total (N=104)
Amoxicillin/clavulanic acid	14 (51.9%)	19 (24.7%)	33 (31.7%)
Cefuroxime	1 (3.7%)	21 (27.3%)	22 (21.2%)
Cefpodoxime-proxetil	0 (0.0%)	23 (29.9%)	23 (22.1%)
Cefixime	0 (0.0%)	9 (11.7%)	9 (8.7%)
Doxycycline	6 (22.2%)	3 (3.9%)	9 (8.7%)
Metronidazole	6 (22.2%)	2 (2.6%)	8 (7.7%)

2.3.3.4.3. Duration of postoperative antibiotics

At the patient level, 210/233 (90.1%) patients received postoperative antibiotics, while only 23/233 (9.9%) received a single preoperative prophylactic dose without postoperative continuation. Among those who received postoperative antibiotics, 3/210 (1.4%) received a single postoperative dose, 17/210 (8.1%) received multiple doses for up to 24 hours, and 190/210 (90.5%) received antibiotics for more than 24 hours (Table 2.18). Of the 210 patients, 136 (64.8%) continued at least one antibiotic from pre-/intra-SAP, while 74 (35.2%) received new postoperative antibiotics.

Table 2:18: Duration of postoperative antibiotic therapy prescribing by hospital sector, surgery and patient details (n = 210)

Variable	Single dose n (%)	≤ 24 h n (%)	> 24 h n (%)
Hospital type			
Public (n=134)	3 (2.2)	16 (11.9)	115 (85.8)
Private (n=76)	0 (0.0)	1 (1.3)	75 (98.7)
Guideline availability			
Complete (n=61)	0 (0.0)	9 (14.8)	52 (85.2)
Partial (n=109)	2 (1.8)	8 (7.3)	99 (90.8)
Not available (n=40)	1 (2.5)	0 (0.0)	39 (97.5)
Procedure urgency			
Elective (n=109)	3 (2.8)	11 (10.1)	95 (87.2)
Emergency (n=101)	0 (0.0)	6 (5.9)	95 (94.1)
Type of surgery			
C-section (n=164)	0 (0.0)	14 (8.5)	150 (91.5)
D&C (n=17)	0 (0.0)	0 (0.0)	17 (100)
Hysterectomy (n=6)	0 (0.0)	0 (0.0)	6 (100)
Other (n=23)	3 (13.0)	3 (13.0)	17 (73.9)
Ward specialty			
GYN (n=14)	1 (7.1)	3 (21.4)	10 (71.4)
Post-natal (n=98)	0 (0.0)	12 (12.2)	86 (87.8)
Mixed (n=98)	2 (2.0)	2 (2.0)	94 (95.9)
Surgical wound classification			
Clean (n=16)	2 (12.5)	2 (12.5)	12 (75.0)
Clean-contaminated (n=192)	1 (0.5)	15 (7.8)	176 (91.7)
Dirty (n=2)	0 (0.0)	0 (0.0)	2 (100)
Overall total (n=210)	3 (1.4)	17 (8.1)	190 (90.5)

When analysed as a continuous variable, the overall median duration of postoperative antibiotic therapy was 3 days (IQR 2-7). Duration was significantly longer in private hospitals compared to public hospitals ($p < 0.001$), with median durations of 7 days (IQR 6–8) and 3 days (IQR 2-3), respectively (Figure 2.8)

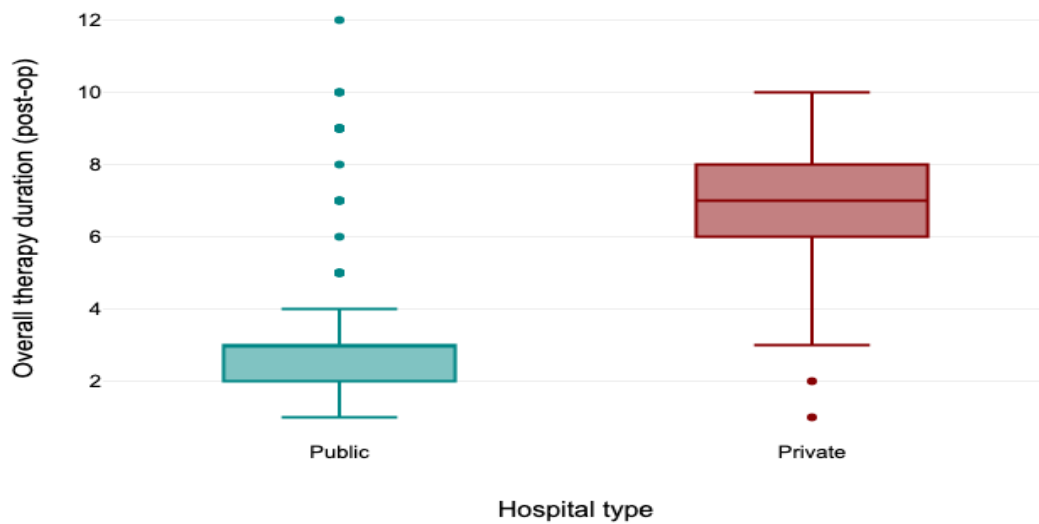


Figure 2.7: Boxplot comparing duration of postoperative antibiotic therapy between public and private hospitals.

Postoperative duration also differed significantly by guideline availability ($p < 0.001$). Hospitals with complete or no guidelines had longer postoperative courses (median 7 days) compared with those with partial guidelines (median 3 days) (Figure 2.9).

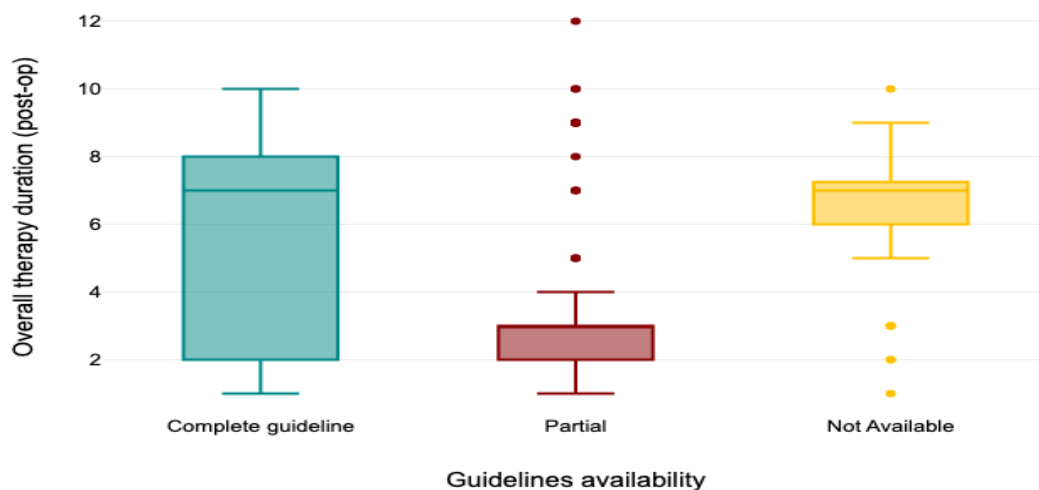


Figure 2.8: Boxplot comparing duration of postoperative antibiotic therapy between hospitals with complete, partial and no local guidelines available.

A significant difference was also observed across surgical procedure types ($p = 0.042$). Median duration was longest for hysterectomy (6 days, IQR 3.65-7.5) and D&C (5 days, IQR 5-8) compared with C-sections (3 days, IQR 2-7) and other procedures (3 days, IQR 2-6). Post-hoc Dunn–Bonferroni analysis showed a significant difference only between D&C and other surgery ($p = 0.043$) (Figure 2.10).

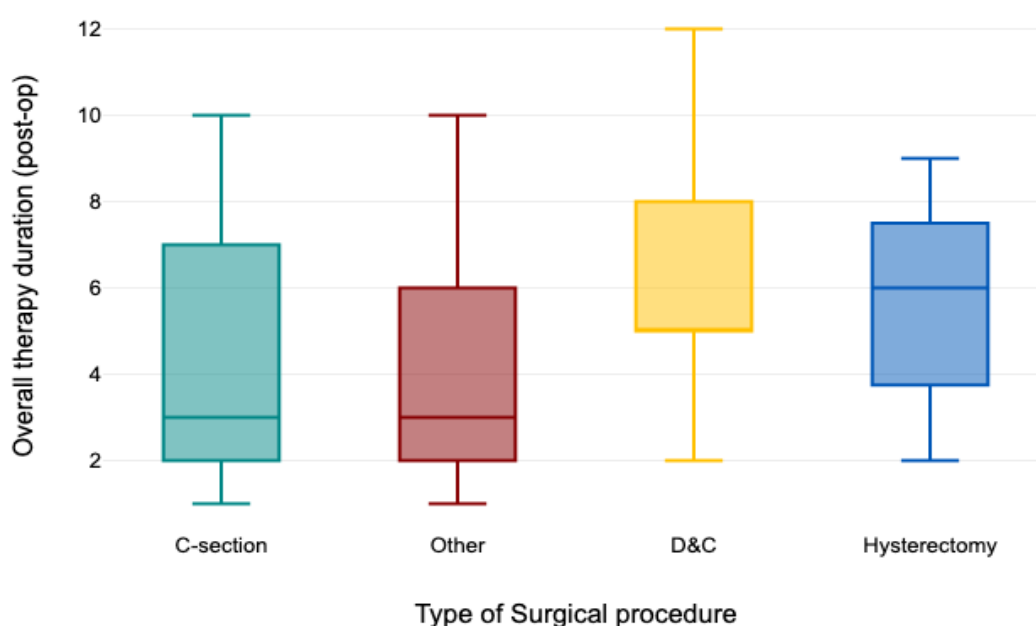


Figure 2.9: Boxplot comparing duration of postoperative antibiotic therapy between types of surgical procedures.

At the medication level, all pre- or intraoperative prophylactic antibiotics were administered as single doses, consistent with SAP guidelines recommendations. However, postoperative continuation was frequent. Among the 445 postoperative antibiotic courses, only 10 (2.2%) were administered as a single postoperative dose, 63 (14.2%) were continued for up to 24 hours, and 372 (83.6%) were extended beyond 24 hours (Table 2.19).

Table 2:19: Duration of postoperative antibiotic prescribing among all prescribed postoperative antibiotic courses (n = 445)

Prescribing practice	n (%)
Single postoperative dose	10 (2.2)
Multiple doses for Up to 24 hours	63 (14.2)
Over 24 hours	372 (83.6)
Total	445 (100)

When duration was analysed as a continuous variable at the medication level, the overall median duration of postoperative antibiotic courses was 2 days (IQR 1-3). Cefuroxime, metronidazole, and ceftriaxone were the most frequently used antibiotics, with median durations of 1-2 days (Table 2.20).

Table 2:20: Duration of all antibiotic courses by agent name (n = 445)

Antibiotic	Median (days)	Q1	Q3	IQR
Cefuroxime	1	1	3	2
Metronidazole	2	1	3	2
Ceftriaxone	1	1	2	1
Amoxicillin/clavulanic acid	5	1	7	6
Cefazolin	1	1	1	0
Piperacillin–tazobactam	1	1	2	1
Cefpodoxime-proxetil	5	5	7	2
Gentamicin	1.5	1	2	1
Doxycycline	5	5	7	2
Cefixime	5	5	5	0
Ampicillin	1	1	1	0
Meropenem	1	1	1.2	0.2
Clindamycin	1	1	1.5	0.2

2.3.3.5. AWaRe classification

When antibiotics were classified according to the WHO AWaRe framework, Watch group antibiotics were the most frequently prescribed, accounting for 383/661 (57.9%) of all antibiotics compared with 278/661 (42.1%) from the Access group (Figure 2.11). This pattern was even more pronounced for SAP, where Watch antibiotics comprised 155/216 (71.8%) compared with 61/216

(28.2%) from the Access group (Figure 2.12). A similar pattern was observed across both public and private hospitals, which relied more heavily on Watch antibiotics than Access antibiotics (Figure 2.13).

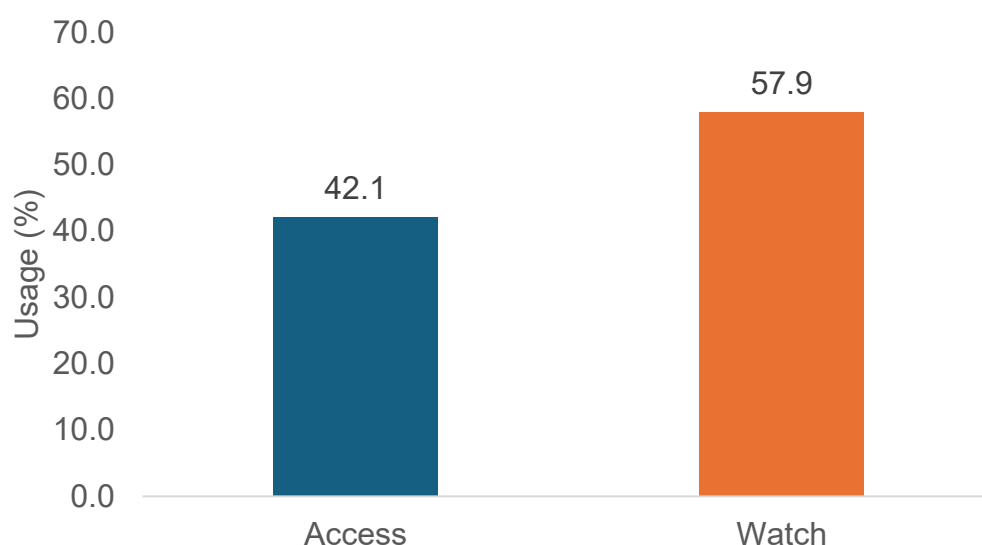


Figure 2.10: Distribution of all prescribed antibiotics according to World Health Organization Access Watch Reserve classification

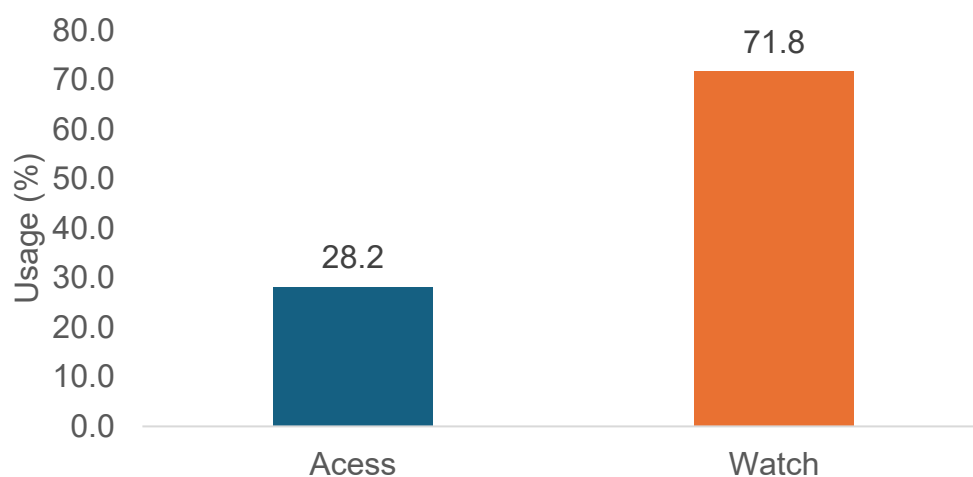


Figure 2.11: Distribution of SAP antibiotics according to the World Health Organization Access Watch Reserve classification

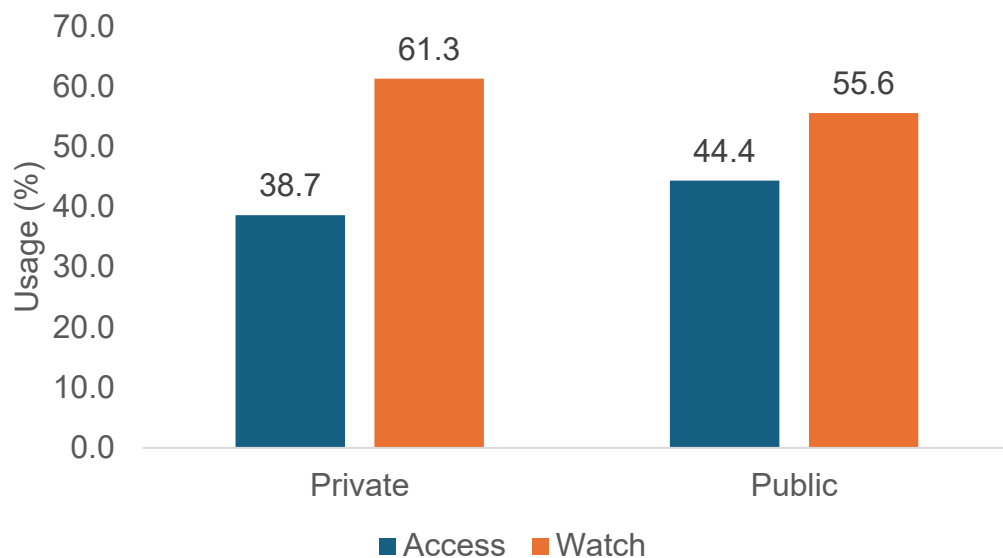


Figure 2.12: Distribution of prescribed antibiotics by hospital sector according to World Health Organization Access Watch Reserve classification

2.3.3.6. Overall compliance assessment of surgical antimicrobial prophylaxis

2.3.3.6.1. Surgical antibiotic prophylaxis compliance per parameter (patient-level)

Compliance with SAP guidelines was assessed for the entire antibiotic regimen (pre-, intra-, and postoperative) among all patients who received pre- or intraoperative SAP (n = 149 local; n = 190 ACOG). Overall, adherence to local guidelines across all parameters was low, mainly due to prolonged postoperative continuation, poor SAP timing, and broad antibiotic selection (Table 2.21).

Table 2:21: Compliance of pre-/intraoperative surgical antibiotic prophylaxis for each parameter against local (N=149) and ACOG guidelines (N=190)

Parameter	Compliant with local guideline n (%)	Compliant with ACOG (2018) guideline n (%)
Indication	141 (94.6)	180 (94.7)
Timing	67 (45.0)	87 (45.8)
Selection	101 (67.8)	98 (51.6)
Dose	111 (74.5)	133 (70.0)
Route	134 (89.9)	172 (90.5)
Duration	9 (6.0)	21 (11.1)

Among all surveyed patients (n = 238), full compliance with every SAP parameter was low. In hospitals with local SAP guidelines (n = 187), only five patients (2.7%) were fully compliant with local guidelines. Across all hospitals (n = 238), only 15 patients (6.3%) met all ACOG (2018) parameters, most of whom were from public hospitals and postnatal wards, and who had undergone C-sections (Figure 2.14 and Table 2.22).

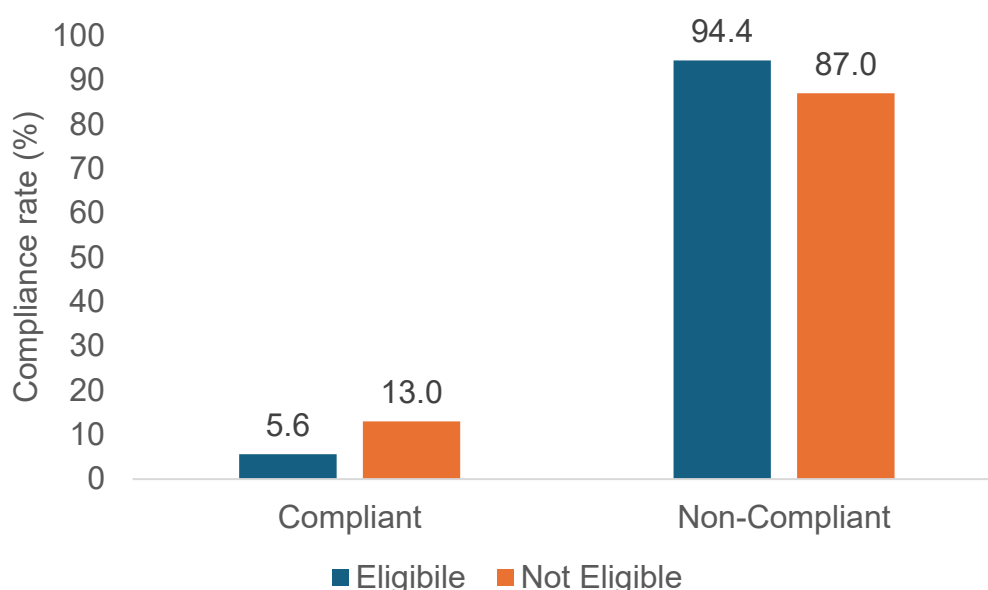


Figure 2.13: Overall prescribing compliance by eligibility for surgical prophylaxis according to the American College of Obstetrics and Gynecologists guidelines.

In the univariate analysis, overall non-compliance with ACOG guidelines was statistically significantly higher in private hospitals compared to public hospitals (100% vs. 90.4%, Fisher's exact $p = 0.003$). Ward speciality was also significantly associated with the compliance rate, with the lowest adherence observed in gynaecology and mixed wards (χ^2 , $p < 0.001$). No statistically significant associations were found with other hospital, surgery, or patient-level factors (Table 2.22). Continuous variables, including patient age, weight, and procedure duration, showed no significant differences between compliant and non-compliant groups (Table 2.23).

Table 2:22: Univariate analysis of factors associated with overall non-compliance with the American College of Obstetrics and Gynecologists (2018) guidelines (patient level, n = 238)

Variable	Overall non-compliance n (%)	Compliance n (%)	Test	p-value
Hospital Type			Fisher	0.003*
Public (n=157)	142(90.4)	15(9.6)		
Private (n=81)	81(100.0)	0(0.0)		
Guideline Availability			Chi-square	0.167
Not available (n=50)	44(88.0)	6(12.0)		
Complete guideline (n=73)	69(94.5)	4(5.5)		
Partial (n=115)	110(95.7)	5(4.3)		
Procedure Type			Chi-square	0.435
C-section (n=183)	174(95.1)	9(4.9)		
D&C (n=19)	17(89.5)	2(10.5)		
Hysterectomy (n=7)	6(85.7)	1(14.3)		
Other (n=29)	26(89.7)	3(10.3)		
Nationality			Fisher	0.602
Kuwaiti (n=128)	121(94.5)	7(5.5)		
Non-Kuwaiti (n=110)	102(92.7)	8(7.3)		
Comorbidities			Fisher	0.427
Absent (n=205)	193(94.1)	12(5.9)		
Present (n=33)	30(90.9)	3(9.1)		
Surgery classification			Fisher	0.602
Emergency (n=141)	133(94.3)	8(5.7)		
Elective (n=97)	90(92.8)	7(7.2)		
Wound Class			Chi-square	0.051
Clean (n=23)	23(100.0)	0(0.0)		
Clean-contaminated (n=212)	201(94.8)	11(5.2)		
Dirty (n=3)	2(66.7)	1(33.3)		

Allergy status			Fisher	1.000
No allergy (n=225)	210(93.3)	15(6.7)		
Allergy present (n=13)	13(100.0)	0(0.0)		
Ward speciality			Chi-square	<0.001*
Post-natal (n=113)	104(92.0)	9(8.0)		
Mix (n=104)	104(100.0)	0(0.0)		
Gyn (n=21)	15(71.4)	6(28.6)		

Table 2:23: Univariate non-parametric comparison of continuous variables between compliant and non-compliant SAP groups (median [IQR])

Variable	Overall non-compliance (median [IQR])	Overall compliance (median [IQR])	Test	p-value
Age (years)	32.9 [28.8–37.2]	32.5 [24.9–34.0]	Mann–Whitney U	0.1788
Weight (kg)	80.0 [70.0–88.0]	71.0 [60.0–87.2]	Mann–Whitney U	0.1650
Procedure duration (min)	45.0 [35.0–60.0]	51.0 [35.0–62.5]	Mann–Whitney U	0.7403

2.3.3.6.2.Surgical antibiotic prophylaxis compliance per parameter (medication-level)

At the medication level, 167 pre- and intraoperative antibiotic prescriptions were assessed against local guidelines, and 216 against ACOG guidelines (2018). Compliance remained low across both standards, with the poorest adherence observed for timing and selection (Table 2.24). However, the duration of pre- and intraoperative SAP prescriptions was not assessed at the medication level, as pre- and intraoperative prescriptions were administered as single doses.

Table 2:24: Individual pre/intraoperative surgical antibiotic prophylaxis Medication-level compliance per parameter

Parameter	Local Guidelines Compliance N=167 n (%)	ACOG (2018) Guideline Compliance N=216 n (%)	Notes
Indication	157/167 (94.6)	197/216 (91.2)	27/353 (7.6%) postoperative antibiotics were compliant with local guidelines but noncompliant with ACOG.
Selection	105/167 (62.9)	102/216 (47.2)	Ten SAP prescriptions (9.5%) were compliant locally but not by ACOG standards.
Timing	73/167 (43.7)	98/216 (45.3)	5/166 (3.0%) SAP antibiotics were appropriate by ACOG but not locally. Documentation of pre-operative SAP orders was missing in 96/215 (44.7%) cases.
Dose	132/167(79.0)	156/216 (72.2)	Five antibiotics were compliant locally but not by ACOG.
Route	152/167 (92.7)	193/216 (89.4)	
Duration	Duration compliance not assessed for pre-/intra-operative		

When all 661 antibiotics prescribed across the perioperative, intraoperative, and postoperative periods were evaluated, overall compliance with ACOG (2018) guidelines remained low (72/661, 10.9%). In terms of pre- and intraoperative SAP, 57/216 (26.5%) were fully appropriate according to ACOG (2018) recommendations. Timing, selection, dose, and duration showed the poorest adherence under both local and ACOG (2018) guidelines, mainly due to the large volume of postoperative prescribing compared to pre- and intraoperative SAP prescribing (Figure 2.15).

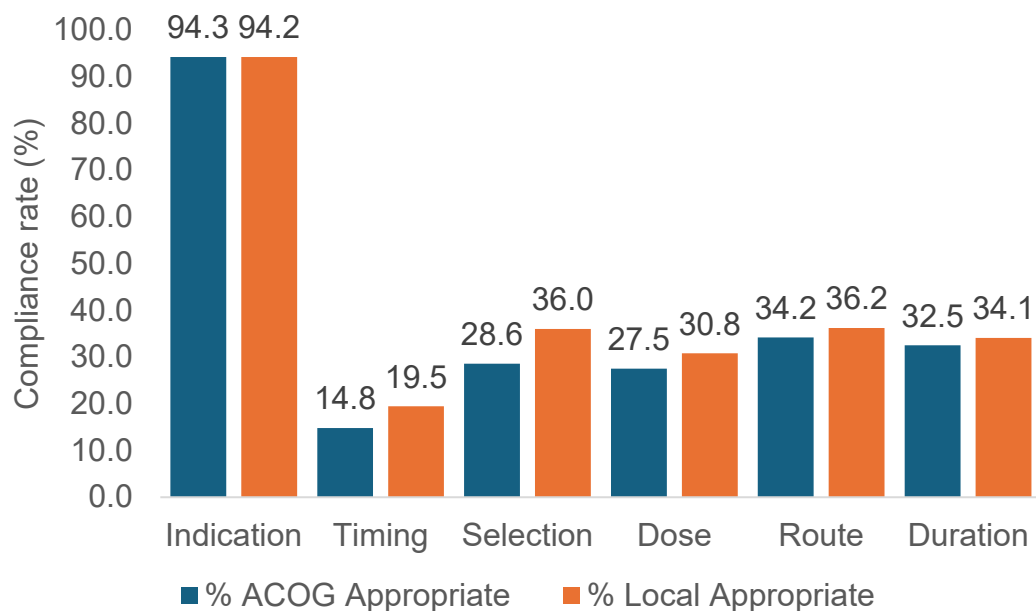


Figure 2.14: Comparison of antibiotic compliance rate per parameter based on American College of Obstetrics and Gynecologists (2018) and local hospital guidelines.

2.3.4. Factors associated with overall non-compliance with surgical antibiotic prophylaxis prescribing (at patient-level)

A multilevel logistic regression model was fitted with hospital as a random intercept to account for patient clustering (Table 2.25). Two factors were

significantly associated with overall non-compliance. Hospitals without local SAP guidelines had 6.25 times higher odds of non-compliance compared with those with partial guidelines ($p = 0.007$). Ward speciality also showed a significant effect, with post-natal wards having 94% lower odds of non-compliance compared to gynaecology wards ($p = 0.046$). No significant associations were observed for hospital type, procedure type, wound class, or urgency of surgery. The intraclass correlation coefficient (ICC) was 0.00, indicating minimal variation between hospitals after adjusting for these predictors.

Table 2:25: Multilevel logistic regression of factors associated with overall non-compliance (patient level, $n = 238$)

Predictor (Reference Category)	Odds Ratio (95% CI)	p-value
Hospital type (Private)	3.14 (0.30–33.08)	0.340
Guideline availability (Partial)		
Not available	6.25 (1.65–23.71)	0.007
Complete guideline	3.48 (0.95–12.71)	0.060
Procedure type (Other)		
C-section	2.27 (0.12–41.44)	0.579
D&C	1.33 (0.12–15.32)	0.821
Hysterectomy	3.28 (0.14–75.00)	0.455
Ward speciality (Gynaecology)		
Post-natal	0.06 (0.004–0.95)	0.046
Mixed	0.06 (0.003–1.16)	0.062
Wound class (Clean/Clean-contaminated)		
Contaminated	0.54 (0.01–23.66)	0.747
Dirty	1.20 (0.03–54.82)	0.925
Surgery classification (Elective)	1.25 (0.42–3.69)	0.685

Model summary: Distribution: Binomial (logit link); AIC: 1242.0; BIC: 1248.8; Overall classification accuracy: 91.6%; Pseudo R^2 (marginal/conditional): 0.13; Intraclass Correlation Coefficient (ICC): 0.00

2.4. Discussion

2.4.1. Summary of main findings

This national, multicentre PPS explored and assessed the prescribing practices of SAP in OB/GYN surgery across nine hospitals in Kuwait, including both public and private sectors. The study provides the first nationwide insight into the pattern and quality of SAP use in this speciality.

Antibiotic use was almost prevalent among all surgical patients, indicating heavy reliance on antibiotics, especially postoperative antibiotic prescribing. However, compliance with local and ACOG (2018) guidelines was poor, particularly in terms of antibiotic selection, timing and duration. Most hospitals routinely extended prophylaxis beyond 24 hours after surgery. This suggests that inappropriate SAP use in Kuwait is mainly driven by overuse and prolonged use, rather than the omission of pre- or intraoperative prophylaxis.

This was also shown in the multilevel analysis, which identified institutional factors, such as the absence of local guidelines and ward speciality, as significant predictors of overall inappropriate prescribing of SAP, affecting both the public and private sectors. In contrast, no patient-related factors had a significant influence on SAP prescribing.

2.4.1.1. SAP prevalence

Antibiotic use in this study was nearly universal, with 233 out of 238 surgical patients (97.9%) received at least one antibiotic at some stage of the surgery (pre-, intra-, or postoperative). This extensive use likely reflects an entrenched

culture of antibiotic prescribing in OB/GYN surgical care in Kuwait. The high prevalence of SAP use can partly be attributed to the predominance of C-section procedures, which require SAP (Scottish Intercollegiate Guidelines Network, 2014; American College of Obstetricians and Gynecologists, 2018; National Institute for Health and Care Excellence (NICE), 2019). However, antibiotics were also administered to 20 of 23 patients (87.0%) in whom prophylaxis was not indicated, suggesting a routine and non-selective prescribing approach that deviates from evidence-based practice.

Comparable patterns have been observed in other LMIC settings. A large prospective observational study conducted in two tertiary hospitals in Central India by Machowska *et al.* (2020) examined antibiotic prescribing among 5,558 OB/GYN inpatients, distinguishing between infectious and non-infectious indications. Antibiotics were prescribed to 81-85% of all patients, including 71-75% of those without an infection or surgical indication. Similarly, a prospective observational study from Egypt by M. Magdy *et al.* (2021) assessed 264 women undergoing obstetric or gynaecological procedures and found that every patient received prophylactic antibiotics irrespective of wound class or indication, with many receiving extended postoperative courses. Likewise, Arteaga-Livias *et al.* (2023) conducted an observational study in two Peruvian hospitals and reported that prophylactic antibiotics were correctly indicated in 55.5% of the cases, with low overall adherence to indication criteria and excessive postoperative continuation. Overall, these prescribing patterns align

with the findings of this study, where antibiotics appear to be used as a precautionary measure rather than a clinical necessity.

In contrast, a large audit from the UK by Lamb *et al.* (2021), which included over 1,000 surgical procedures, found that SAP use among non-eligible patients was only 4.1%, reflecting a well-established antimicrobial stewardship (AMS) infrastructure, a continuous audit system, surveillance of antibiotics, and accountable prescribing. Despite Kuwait being a high-income country (HIC), its SAP prescribing pattern mirrors those of LMICs, which have limited stewardship implementation.

While some clinicians may justify this high rate of SAP as a preventive measure against postoperative infections, such overuse is more likely to reflect defensive prescribing. A practice driven by perceived medical and legal risks, fear of complications, or patient expectations rather than clinical evidence-based decision-making (Ortashi *et al.*, 2013). Moreover, the lack of audit feedback and the absence of standardised national SAP guidelines may reinforce this prescribing behaviour, leading to routine rather than selective prophylaxis.

Another contributing factor for such behaviour may be the misclassification of wound categories, resulting in prescribing antibiotics “just in case”. A retrospective U.S. study by Joyce *et al.* (2017), which examined the use and documentation of SAP in 326 gynaecological surgery, reported frequent

wound misclassification that led to unnecessary antibiotic administration. This prescribing behaviour pattern is consistent with the study's findings, where antibiotics were prescribed even for clean or minimally invasive procedures.

Beyond the economic burden, excessive SAP use exposes patients to avoidable adverse events such as allergic reactions, gastrointestinal disturbances, *Clostridium difficile* infection, and AMR (Branch-Elliman *et al.*, 2019). A study by Tamma *et al.* (2017), found that up to 20% of 1,488 hospitalised inpatients experienced antibiotic-related side effects, many without an appropriate indication. Collectively, these studies underscore that high SAP prevalence in Kuwait may reflect a systemic and cultural prescribing behaviour rather than an individual issue, a prescribing culture that values defensive prescribing rather than evidence-based prescribing. Addressing this requires the implementation of AMS, enhanced prescriber education, and clear national guidelines to ensure the proper utilisation of antibiotics when indicated.

2.4.2. Compliance with surgical antibiotic prophylaxis guidelines

Globally, compliance with SAP guidelines remains suboptimal despite the evidence of guidelines' effectiveness in reducing SSI (Gouvea *et al.*, 2015; Khan *et al.*, 2021; Mwita *et al.*, 2021). Many previous studies have shown that inappropriate SAP prescribing, especially prolonged postoperative use for more than 24 hours, poor timing and selection of broad-spectrum antibiotics, remain a constant problem. In Australia, a national audit of 15,395 SAP

prescriptions found that only 48.7% were appropriate, mainly due to extended duration and incorrect timing (Ierano *et al.*, 2019a). Similarly, the Global PPS in 2015, assessing antimicrobial prescribing across 53 countries, found that SAP was commonly prescribed for more than 24 hours across all regions, ranging from 40.6% to 86.3% in Oceania to Eastern Europe (Versporten *et al.*, 2018). Likewise, another Global PPS study across 248 hospitals from 74 countries reported that 60.9% of SAP were prescribed for more than 24 hours, which was mainly attributed to systemic and behavioural challenges (Pauwels *et al.*, 2021b). Overall, in these studies, which were primarily conducted in developed countries with well-established AMS, adherence to SAP guidelines continued to be suboptimal.

In LMICs, adherence rates were significantly poorer and largely driven by systemic weakness. Studies from Egypt, Ethiopia, Ghana, and Nigeria have all reported very poor overall compliance with SAP guidelines, mainly due to a lack of awareness of guidelines, inadequate AMS, inadequate surveillance, lack of accountability, and defensive prescribing behaviour. For example, in Northern Nigeria, a multicentre PPS by Abubakar (2020) involving 321 inpatients found that, out of all patients, SAP was prescribed for 36.9% of all indications and 94.8% of the SAP regimens were continued for more than 24 hours, and there was a strong dependence on broad-spectrum antibiotics such as ceftriaxone. In Ghana, an audit at a teaching hospital by Sefah *et al.* (2022), found an overall compliance rate of only 2.5%, mainly due to prolonged broad-spectrum antibiotics and lack of guidelines implementation. Similarly, a mixed

method study in Egypt by Ali *et al.* (2025), found that none of the 280 surgical patients achieved full adherence to guidelines, attributing this to workflow inefficiencies, limited antibiotic availability, and misconceptions regarding SSI prevention. In Tanzania, Schrama *et al.* (2025), observed that 67% of SAP courses exceeded 24 hours due to habitual and defensive prescribing. Collectively, these studies indicate that in many LMICs, inappropriate SAP practice arises not from clinical uncertainty but from entrenched cultural and institutional norms that normalise excessive antibiotic use.

This pattern was also observed in the present study, where overall SAP compliance with ACOG (2018) guidelines was 6.3% (15/238), and just 72 of 661 (10.9%) antibiotic courses were fully appropriate at the medication level. Adherence varied across parameters, with timing (46.3%) and duration (12.1%) being the weakest parameters. These patterns reflect partial compliance with guidelines, where SAP is commonly prescribed and administered but inconsistently aligned with SAP guidelines. The findings suggest that behavioural and institutional rather than purely knowledge-based barriers may underpin non-compliance.

Despite Kuwait being a High-income country, the pattern of non-compliance observed mirrors that of LMICs more than that of other high-income settings. This likely reflects underlying institutional and behavioural barriers, including limited AMS implementation, inconsistent access to updated guidelines, and entrenched prescribing routines that favour extended prophylaxis “just in

case". In contrast, higher compliance rates were reported compared to other HICs, which may suggest a more robust AMS infrastructure. For example, a retrospective multicentre audit across 26 hospitals in France reported an overall full compliance with national surgical prophylaxis guidelines, a rate of 64% among 2303 surgical patients (Prévost *et al.*, 2021).

The most prominent deviation from guidelines was duration, where 190/210 of patients (90.5%) received postoperative antibiotics for more than 24 hours, contrary to ACOG, SIGN, NICE, and WHO recommendations for single dose (Scottish Intercollegiate Guidelines Network, 2014; Berrios-Torres *et al.*, 2017; American College of Obstetricians and Gynecologists, 2018; National Institute for Health and Care Excellence (NICE), 2019). Despite guidelines recommending single-dose SAP (American College of Obstetricians and Gynecologists, 2018; National Institute for Health and Care Excellence (NICE), 2019), oral antibiotics were also frequently prescribed postoperatively without documented justification. Similar patterns have been reported in LMICs, with duration compliance rates ranging from 1-30% and treatment durations extending up to 12 days (Abubakar *et al.*, 2018; Bunduki *et al.*, 2020; Sefah *et al.*, 2022; Habteweld *et al.*, 2023; Ali *et al.*, 2025). In Kuwait, this behaviour likely stems from a defensive prescribing culture, or habitual prescribing or might be due to poor AMS oversight. Without structured audit and feedback mechanisms, prescribers often continue to prescribe "just in case", fearing postoperative complications or patient complaints. Such behaviour can expose patients to unnecessary adverse effects such as GI disturbances, AKI, besides

increasing medical costs and contributing to AMR (Tamma *et al.*, 2017; Branch-Elliman *et al.*, 2019). In contrast, studies from HICs such as the UK and Italy reported duration compliance rates of 70–80% and shorter median durations of 1-2 days (Segala *et al.*, 2020; Lamb *et al.*, 2021).

Antibiotic selection was another major contributor to SAP's overall non-compliance. Cephalosporins accounted for 74.1% of all SAP prescriptions, dominated by cefuroxime and ceftriaxone (agents of the WHO Watch list), while cefazolin, the ACOG-recommended first-line (Access) antibiotic, was rarely used (Bratzler *et al.*, 2013; American College of Obstetricians and Gynecologists, 2018). This preference for broader-spectrum agents reflects misconceptions about their superior efficacy, a pattern also reported in Egypt, South Africa, and Vietnam (Van Tuong *et al.*, 2021; Jordaan *et al.*, 2023; Ali *et al.*, 2025). Moreover, the tendency to combine cephalosporins with metronidazole for postoperative coverage, especially in C-sections, mirrors practices in Nigeria, Tanzania and Egypt, where such regimens were deemed unnecessary and inconsistent with guidelines (Abubakar *et al.*, 2018; M. Magdy *et al.*, 2021; Ali *et al.*, 2025; Schrama *et al.*, 2025). In Kuwait, this over-reliance on watch-list antibiotics despite the availability of narrow alternatives highlights the absence of formulary control, audit, and feedback implementation. Studies have shown that stewardship interventions such as local antibiotic restriction policies and pharmacist-led audit and feedback can significantly improve SAP selection and reduce broad-spectrum use (Jantarathaneewat *et al.*, 2022; Doğan *et al.*, 2024b; Sefah *et al.*, 2025).

Timing compliance (46.3%) was also suboptimal, with less than half of SAP doses administered within 60 minutes before incision. Timely antibiotic delivery is crucial to achieve optimal tissue concentration at the site of incision (Berrios-Torres *et al.*, 2017; de Jonge *et al.*, 2017a; Alemkere, 2018; World Health Organization, 2018a). Similar compliance levels have been documented in several LMICs, such as Pakistan (40.7%), Ethiopia (53.3%) and Nigeria (16.5%) (Abubakar *et al.*, 2018; Khan *et al.*, 2020a; Alemkere *et al.*, 2023). Compared with 78-99% in HICs such as France and the US (Bardia *et al.*, 2021; Prévost *et al.*, 2021). In Kuwait, inconsistent timing is likely due to weak communication and unclear responsibility between anaesthetists and surgeons, compounded by incomplete documentation of preoperative SAP operators and administration times of SAP. These findings suggest that systemic workflow challenges may exist, requiring coordinated perioperative protocols rather than individual reminders.

Dosing was relatively more compliant (139/190, 73.2%) yet inconsistently aligned with guideline recommendations. Over- or underdosing was most frequent with ceftriaxone and amoxicillin/clavulanic acid, suggesting variable prescriber familiarity with recommended regimens. These findings underscore the need for clearer dosing guidance, prescriber education, and stewardship oversight to optimise SAP dosing and reduce unnecessary antimicrobial exposure (Prévost *et al.*, 2021; Romero Viamonte *et al.*, 2021; Jordaan *et al.*, 2023).

While high compliance in route (172/190, 90.5%) indicates that IV prophylaxis is well established, it aligns with previous studies (Bunduki *et al.*, 2020; Prévost *et al.*, 2021; Schrama *et al.*, 2025). Other studies from South Africa, Vietnam, and Pakistan reported a 100% compliance rate (Khan *et al.*, 2020b; Van Tuong *et al.*, 2021; Jordaan *et al.*, 2023). However, this strength was undermined by the continuation of oral antibiotics post-discharge (104 prescriptions), especially in private hospitals, which suggest a persistent misconception that prolonged oral “coverage” ensures safety after discharge, a behaviour that contradicts ACOG and NICE guidelines recommendations and reinforces the influence of local prescribing culture (American College of Obstetricians and Gynecologists, 2018; National Institute for Health and Care Excellence (NICE), 2019).

The multilevel regression analysis confirmed that institutional rather than patient-level factors were the main influencing factors of non-compliance. Hospitals without local SAP guidelines had 6.3-fold higher odds of overall inappropriate SAP prescribing compared with those with partial guidelines ($p = 0.007$), and ward speciality (post-natal vs. gynaecology) also significantly influenced compliance. This shows that structural and institutional factors drive practice variation. This aligns with international evidence that the presence of guidelines alone does not ensure adherence unless accompanied by implementation support, education, and an audit system (Davari *et al.*, 2018; Pereira *et al.*, 2022).

Furthermore, the persistence of low compliance across both public and private hospitals in Kuwait suggests that SAP inappropriateness is embedded in institutional norms rather than individual negligence. Defensive prescribing, hierarchical decision-making and limited multidisciplinary engagement likely perpetuate these behaviours, as observed in similar Middle Eastern settings (Al Awar *et al.*, 2024; Ali *et al.*, 2025).

Overall, these findings reveal that the problem is not a lack of awareness but rather the absence of institutional accountability and behavioural reinforcement mechanisms. Kuwait's SAP practice patterns resemble those of LMIC despite its high-income status, reflecting structural gaps in policy enforcement and stewardship integration. To optimise SAP practice, a coordinated national strategy is required, combining unified SAP guidelines, mandatory audit and feedback and continuous education across disciplines. Only through systemic stewardship can Kuwait transition from defensive and habitual antibiotic use toward evidence-based, patient-centred prophylaxis practice.

2.4.3. Clinical implications and recommendations

This study revealed consistently poor adherence to SAP guidelines across both public and private OB/GYN hospitals in Kuwait, indicating systemic rather than individual issues in SAP prescribing. The findings highlight the need to improve the accessibility, implementation, and institutional enforcement of

local SAP guidelines. Non-adherence, particularly in antibiotic selection, timing, and duration, suggests that guidelines are not being consistently integrated into everyday surgical workflow (whether due to limited accessibility, habitual prescribing patterns, or the absence of audit and accountability mechanisms). While knowledge gaps may contribute in some cases, the PPS data alone cannot distinguish between lack of awareness and failure to apply known recommendations in practice; this question is explored in Chapters 3 and 4.

At the institutional level, interventions should prioritise regular multidisciplinary training and awareness programmes for surgeons, anaesthetists, pharmacists and nurses to promote shared understanding of appropriate SAP practice. Given the suboptimal timing of prophylaxis, structured coordination between surgical and anaesthetic teams should be incorporated into operating theatre protocols to ensure administration at the recommended pre-incision window. Furthermore, establishing AMS teams within hospitals is crucial for monitoring SAP prescribing, providing real-time feedback, and conducting regular audits to sustain improvement.

To address the observed overuse of broad-spectrum antibiotics, hospital formularies and local protocols should be reviewed to favour the WHO “Access” list antibiotics, such as cefazolin and restrict the routine use of “Watch” list antibiotics, such as cefuroxime and ceftriaxone. The common continuation of postoperative antibiotics beyond the recommended duration

underscores the need to reinforce duration restrictions within perioperative workflows and discharge procedures.

Improving documentation quality is also important to ensure accountability and enable meaningful audits. Standardised recording of indications, timing and duration, integrated within an electronic health system or surgical checklists, would support better monitoring and compliance.

Because adherence varied across ward specialities, hospitals should ensure that local guidelines are completed for all types of procedures, clearly written and widely disseminated across wards. Also, the guidelines should be adapted to each ward's workflow and implemented accordingly. At the national level, the Ministry of Health of Kuwait should consider establishing a central antimicrobial surveillance and benchmarking system to routinely track SAP prescribing trends, compare adherence across hospitals, and promote accountability.

Collectively, these measures would ensure that SAP guidelines in Kuwait are not only available but effectively implemented, monitored and reinforced through continuous education, audits, and stewardship to bridge the current gap between practice and policy.

2.4.4. Strengths and limitations

2.4.4.1. Strengths

This study represents the first national PPS to evaluate SAP prescribing practices in OB/GYN surgery across both public and private hospitals in Kuwait, offering a comprehensive overview of prescribing trends and compliance within this speciality. It applied validated GPPS and WHO-PPS methodologies that were piloted for reliability and reproducibility, ensuring consistency and methodological rigour. Additionally, the inclusion of all major public hospitals and a representative sample of the top four private hospitals in Kuwait enhanced the generalisability of the findings across Kuwait's OB/GYN surgical practice.

A major strength of this study was its multilevel assessment of SAP compliance against both hospitals' local and the ACOG (2018) guidelines as a standardised reference across all hospitals. Compliance was evaluated across all key parameters, including indication, selection, timing, dose, route and duration, and examined at both the patient level (overall compliance) and medication level (parameter-specific compliance and overall compliance for each antibiotic prescribed). This dual-level analysis provided deeper insights into prescribing behaviour and compliance with SAP parameters. Assessing local compliance and ACOG appropriateness enabled standardised cross-hospital comparison. Beyond measuring compliance, this study provided actionable targets for stewardship improvement, particularly in terms of timing, duration and selection of SAP.

Moreover, the use of both descriptive and inferential statistics, including univariate analysis and multilevel logistic regression, provided an initial attempt to predict institutional, structural, and clinical predictors of overall inappropriate prescribing. Importantly, the study also highlighted secondary quality indicators such as the WHO AWaRe list utilisation and poor SAP documentation, providing areas for quality improvement.

2.4.4.2. Limitations

Several limitations should be considered when interpreting the findings of this study. First, as a PPS design, the data were captured at a single point in time, which captures prescribing practices on one specific day and may not reflect temporal or seasonal variations in SAP use. This was mitigated by including nine hospitals across different governorates and sectors, enhancing representativeness and reducing the likelihood that the results reflect isolated practices.

Second, the accuracy of the data relied on the quality of the medical records. Incomplete or unclear documentation, especially regarding wound classification, indication, and antibiotic duration, may have led to some misclassification of SAP appropriateness. To minimise this, a standardised WHO/GPPS tool was used, and for any ambiguous cases, a discussion with the surgical and nursing staff was held when possible, to verify the case.

Third, while this study focused on OB/GYN surgery, which may limit generalisability to other surgical disciplines, the impact is likely minimal, as most OB/GYN procedures share similar wound classification and SAP principles with other specialities.

Fourth, the assessment of SAP appropriateness was based primarily on ACOG (2018) guidelines, which may not be fully identical to local protocols in all hospitals. However, this approach allowed for standardised benchmarking across institutions, and compliance was also assessed against local guidelines, where available, to reduce any potential bias.

Fifth, during multilevel logistic regression analysis, several hospitals had complete outcome separation (all cases were inappropriate), which caused estimation of infinite odds ratios and model instability. To enable model stability, a single complaint case was added to each fully non-compliant variable/hospital to address xero-cell bias. This modification did not materially affect the interpretation of the results, but it allowed for the estimation of between-hospital variability and ensured model stability.

Finally, the regression model was limited by the scope of the collected data. As this PPS was designed mainly to explore the prescribing practice rather than to predict inappropriate SAP prescribing, detailed patient-level variables such as infection risk or prior antibiotic exposure) were not collected or included in the model. Consequently, the regression findings should be

interpreted as exploratory and descriptive rather than predictive. Despite these limitations, this study provides the first national benchmark of SAP prescribing in Kuwait and highlights actionable targets for AMS and quality improvement at both the institutional and national levels.

2.4.5. Conclusion

This national point prevalence survey provides the first comprehensive evaluation of SAP prescribing practices in OB/GYN surgery across Kuwait's public and private hospitals. The findings demonstrate that antibiotic use was nearly universal among surgical patients, yet adherence to guideline-recommended SAP practice was poor. While 215 of 238 patients (90.3%) were eligible for SAP, only 15 patients (6.3%) received fully appropriate prophylaxis according to the ACOG (2018) guideline. At the medication level, 72 of 661 antibiotic prescriptions (10.9%) were fully appropriate.

The most significant gaps were observed in antibiotic selection, timing, and especially duration, with 190 of 210 postoperative antibiotic courses (90.5%) exceeding 24 hours. Cephalosporins, particularly cefuroxime and ceftriaxone, were predominantly used, reflecting a strong reliance on broad-spectrum "Watch" group agents rather than "Access" antibiotics recommended by the WHO. These findings suggest that inappropriate SAP prescribing in Kuwait is primarily driven by overuse and prolonged postoperative continuation, rather than the omission of prophylaxis.

Overall, poor compliance appears to be institutionally rather than patient-driven, underscoring systemic issues in stewardship implementation, documentation, and adherence to existing guidelines. Improving SAP quality and minimising antimicrobial resistance risks will require a coordinated national response, emphasising consistent dissemination and implementation of SAP guidelines, continuous prescriber education, audit and feedback mechanisms, and the integration of antimicrobial stewardship programmes across all hospitals. This study establishes an essential evidence base to guide future clinical policy, support stewardship initiatives, and optimise the quality and safety of surgical prophylaxis in Kuwait.

Chapter 3. Knowledge, Attitude and Practice of Gynaecologists and Obstetricians Towards Surgical Antimicrobial Prophylaxis in Public and Private Hospitals in Kuwait

3.1. Introduction

Surgical antibiotic prophylaxis (SAP) is a vital measure in preventing surgical site infections (SSIs), which are associated with increased morbidity, mortality and healthcare costs (Sartelli *et al.*, 2021; Totty *et al.*, 2021). The American College of Obstetricians and Gynecologists (2018) (ACOG) guideline for SAP recommends specific antibiotics, timing, and duration to maximise efficacy and minimise risks of post-operation infections. Despite the availability of international and local guidelines for SAP, adherence to these guidelines remains suboptimal in many countries (Gouvea *et al.*, 2015), including Kuwait, as shown in Chapter 2.

Previous worldwide studies reported extensive misuse of SAP, characterised by inappropriate selection, inappropriate time of administration, and prolonged duration (Gouvea *et al.*, 2015; Argaw *et al.*, 2017; Mwita *et al.*, 2021; Santos *et al.*, 2021; Ali *et al.*, 2025). A prospective clinical trial by Classen *et al.* (1992), showed that administering SAP at an incorrect time, either too early or too late, can lead to a significant increase in the rate of SSIs. Similar patterns were observed in Kuwait, as shown in Chapter 2, where noncompliance with guidelines was common, especially delayed or unrecorded prophylaxis timing, inappropriate antibiotic selection, and prolonged postoperative use. This underscores the ongoing presence of these global issues within the national context. Prolonged antibiotic prophylaxis beyond the recommended duration not only fails to prevent infection but also increases the risk of antibiotic-

associated side effects and promotes antimicrobial resistance (AMR) (Branch-Elliman *et al.*, 2019; Sartelli *et al.*, 2021).

In Kuwait, a retrospective study found that the SSI following Caesarean section (C-sections) operations increased from 1.7% to 2.9% from 2014 to 2016 (Alfouzan *et al.*, 2019), which was mainly attributed to the absence or poor SAP administration and emergency surgery. Similarly, a recent systematic review and meta-analysis found a pooled SSI prevalence following C-section of 3.0%, and the study also identified inappropriate timing and absence of SAP as major contributors to this prevalence (Alshahrani *et al.*, 2025). These findings highlight the regional challenges of suboptimal SAP prescribing, which persists despite the high-income status and resource availability of these countries. Such deficiencies in SAP prescribing are often underpinned by gaps in clinicians' knowledge, awareness, and education regarding appropriate prophylaxis use (Gouvea *et al.*, 2015; Hassan *et al.*, 2021).

The findings of Chapter 2 demonstrated poor compliance with SAP guidelines in Kuwait; however, they did not explain the underlying reasons for this suboptimal practice. Therefore, it is necessary to further investigate whether deficiencies in knowledge, attitude, and practice (KAP) of obstetricians, gynaecologists or anaesthetists contribute to this inappropriate prescribing behaviour. Understanding the KAP of these key prescribers can provide valuable insight into whether gaps in awareness or misconceptions about SAP use are contributing to the poor compliance observed in Kuwait. This

understanding is essential for developing and implementing targeted interventions to improve SAP practice, enhance guideline compliance, and ultimately reduce the risks associated with inappropriate antibiotic use in OB/GYN surgery.

3.1.1. Research question:

What is the overall knowledge, attitude, and practice of OB/GYN surgeons and anaesthetists towards SAP and SAP guidelines and prescribing in private and public hospitals in Kuwait?

3.1.2. Research aims

The aim of this study was to assess the knowledge, attitudes, and practice of gynaecologists, obstetricians, and anaesthetists regarding SAP in public and private hospitals in Kuwait. Additionally, this study investigated the factors associated with knowledge, attitudes, and practice in this area.

3.1.3. Secondary outcomes:

The secondary outcomes of the study were to:

- Examine the influences of demographic and professional characteristics (e.g., years of experience, country in which participants received their medical training, speciality and hospital type) on participants' knowledge, attitude, and practice regarding SAP.

- Compare knowledge, attitudes, and practice between public and private sectors, and between obstetricians, anaesthetists, and different seniority levels (consultants, registrars, etc.).
- Assess the interrelationships between knowledge, attitude, and practice, including whether higher knowledge and a more positive attitude translate into better SAP prescribing practice.
- Identify key factors associated with higher knowledge, positive attitudes, and better adherence to SAP guidelines.
- Propose evidence-based strategies to optimise SAP practice in Kuwait.

3.2. Method

3.2.1. Study design and data sources

3.2.1.1. Study design

A national, non-experimental, cross-sectional survey was conducted among obstetricians/gynaecologists and anaesthetists using a standardised self-administered survey between July 9th, 2023, and September 10th, 2023.

3.2.1.2. Questionnaire content

The questionnaire was developed based on the findings in Chapter 2, current SAP guidelines from the ACOG (2018), and published studies (Ahmed *et al.*, 2019; Abubakar *et al.*, 2020; Khan *et al.*, 2020c). The questionnaire was developed from scratch rather than adopting an existing instrument, for several methodological reasons. First, at the time of development, no validated KAP tool specifically addressing SAP in OB/GYN surgery was available in the published literature. Existing studies on SAP (Ahmed *et al.*, 2019; Abubakar *et*

al., 2020; Khan *et al.*, 2020c) had developed their own context-specific tools for general surgical settings in low-income countries (Sudan, Nigeria and Pakistan), and these instruments were not designed or validated for use in Gulf Cooperation Council healthcare settings. Adapting these instruments directly may have risked poor construct validity given the significant differences in healthcare system structure, resources and guideline preferences between those contexts and Kuwait. Second, and critically, the sequential mixed-methods design of this thesis required the KAP tool to be directly informed by the PPS findings from Chapter 2. Two knowledge items were specifically constructed to address antibiotic use patterns identified in the Kuwait PPS (e.g., the frequent use of cefuroxime and ceftriaxone rather than cefazolin, and the extension of prophylaxis beyond 24 hours), which no pre-existing instrument could capture. Third, the tool needed to assess knowledge relative to the ACOG (2018) guideline, which was used as the compliance benchmark in Chapter 2, ensuring conceptual alignment across the sequential studies. The questionnaire was therefore developed drawing on the structure and item content of prior SAP KAP studies (Ahmed *et al.*, 2019; Abubakar *et al.*, 2020; Khan *et al.*, 2020c) as methodological reference points, while constructing items tailored to the OB/GYN context, the Kuwaiti healthcare system, and the specific prescribing gaps identified in Chapter 2.

The questionnaire consisted of 46 items in four sections: (1) demographics, (2) knowledge, (3) attitudes, and (4) practice (Appendix 3.1). The survey was

available in both English and Arabic to accommodate participants' preferences and response accuracy.

The four sections collected data on:

- **Demographics:** Information related to participants' characteristics, such as gender, age, speciality, medical experience, level of practice, and workplace and country from which they obtained their medical training. These variables were included to explore potential associations between demographic and variation in SAP knowledge, attitudes and practice.
- **Knowledge:** This section aimed to assess clinicians' understanding of SAP principles and appropriate SAP use. Two initial items assessed participants' awareness and self-reported use of local/international guidelines; these were included for descriptive purposes and were not scored. The remaining part of the section consisted of ten multiple-choice questions (MCQs) measuring knowledge on SAP indication, timing, antibiotic selection, duration and dosing, mainly driven by the ACOG (2018) and the British National Formulary (BNF) for commonly prescribed antimicrobials.
 - The first two MCQs had more than one correct answer regarding surgical wounds and the type of surgery for which they would prescribe SAP. The first question had four correct answers, and the second question had five correct answers.

- The remaining eight MCQs had only one correct answer, six of which were based on ACOG (2018) and two related to antimicrobial use patterns identified in Chapter 2 (Appendix 3.1).

This design is to ensure a full coverage of both general SAP principle understanding and Kuwait-specific prescribing gaps identified in Chapter 2.

- **Attitudes:** This section was designed to explore participants' beliefs regarding the usefulness of SAP local/international guidelines, adherence feasibility, and the importance of antimicrobial stewardship. It comprised 12 Likert-scale statements rated on a 5-point Likert scale (strongly disagree, somewhat disagree, neither, somewhat agree, strongly agree). The Likert scale is a psychometric scale commonly used in survey questionnaires (Likert, 1932). The items were developed to capture key motivational drivers of SAP adherence to support antimicrobial stewardship practices.
- **Practice:** This section evaluated participants' self-reported behaviour and adherence to SAP guidelines in their routine surgical practice. It contained 14 Likert-scale statements assessing the frequency of certain SAP-related practices (never, rarely, sometimes, most of the time, always).
- In addition, this section included a question asking participants to rank potential strategies for optimising SAP prescribing in Kuwait (e.g., education, audit feedback, development of national guidelines, research). This was aimed at prioritising future stewardship interventions and determining the most suitable or demanded

intervention for future studies. These strategies were selected based on evidence from the World Health Organization (WHO) and international systematic reviews, which identify these five components as key antimicrobial stewardship interventions for optimising antibiotic prescribing practice (World Health Organization, 2015; Langdridge *et al.*, 2024; Sefah *et al.*, 2024).

3.2.1.3. Questionnaire validation and piloting

The draft questionnaire was reviewed by the project supervisors for feedback. This feedback was addressed and discussed during meetings to finalise questions. The refined version was then evaluated by two independent academic reviewers with expertise in survey design and SAP research to assess content and face validity. Their feedback resulted in modifications to the questionnaire flow on the online platform (Qualtrics®), adjustments to the participant information sheet and rewording of questions for clarity. The final questionnaire was piloted with five OB/GYN physicians to assess comprehension, clarity and completion time. These participants were excluded from the main analysis. No further changes were made after piloting, and the average time to complete the survey was approximately 10 minutes. Reliability testing was conducted in SPSS version 28.0® using Cronbach's alpha to assess the items' internal consistency for the attitude and practice sections. Cronbach's alpha was not calculated for the knowledge section because these items were scored as right-or-wrong responses and covered several different aspects of SAP knowledge rather than one unified area of knowledge (Tavakol

et al., 2011; Taber, 2018). The coefficients for the attitude and practice sections were 0.65 and 0.70, respectively, indicating moderate to good reliability (Taber, 2018). The formula below represents Cronbach's alpha:

$$\alpha = \frac{K}{K-1} \left(1 - \frac{\sum_{i=1}^K \sigma^2 y_i}{\sigma^2 x} \right)$$

Where:

- K is the number of items in the scale
- $\sigma^2 y_i$ is the variance of each item, and
- $\sigma^2 x$ is the variance of the total scores across all items.

3.2.1.4. Data source:

The primary data sources were the responses collected from the online platform Qualtrics® and the paper-format questionnaire in the hospitals.

3.2.1.5. Ethical approval

The Ministry of Health in Kuwait granted this research ethics approval (Appendix 3.2), and it was subsequently endorsed by the Strathclyde Institute of Pharmacy and Biomedical Sciences (SIPBS) Ethics Committee.

3.2.2. Study participants and setting

3.2.2.1. Study participants

The study targeted all OB/GYN surgeons and anaesthetists from all levels of practice working in Kuwait's public and private hospitals. These professionals were selected because they are directly responsible for prescribing,

administering, and overseeing SAP in OB/GYN surgery. Kuwait has five public hospitals with OB/GYN departments and 21 private hospitals. The total targeted population was 1388 doctors from both specialities (Table 3.1) (M.Alrajhi, personal communication, November 5, 2023).

Table 3:1: Distribution of obstetrics, gynaecology, and anaesthetists staff across the public and private sectors

Speciality	OB/GYN	Anaesthetists	Total
Public	285	335	620
Private	480	288	768
Total	765	623	1388

3.2.2.2. Sample size calculation

The minimum required sample size was calculated using an online sample size calculator (Calculator.net) (<https://www.calculator.net/sample-size-calculator>). Assuming a total population of 1,388, a 95% confidence interval, a 5% margin of error, and a 50% response distribution, the minimum sample size required was 302 participants to ensure representativeness and generalisability of results (Appendix 3.3).

3.2.2.3. Inclusion criteria

OB/GYN surgeons and/or anaesthetists who were responsible for prescribing SAP for patients undergoing OB/GYN surgery and who were willing to participate voluntarily in the online or paper survey.

3.2.2.4. Exclusion criteria

Healthcare professionals who are not responsible for prescribing SAP for patients undergoing OB/GYN surgery.

3.2.2.5. Study recruitment strategies

The survey used convenience sampling, targeting both OB/GYNs and anaesthetists. The survey was distributed with the approval of the chairman of the OB/GYN department at the Ministry of Health, who was also the head of the OB/GYN society in Kuwait. A communication officer (an OB/GYN doctor) appointed by the OB/GYN chairman facilitated the distribution of the survey link through the Kuwait Medical Association, the body for all medical specialities in Kuwait. The Association distributed the survey through its main communication channels (email and WhatsApp®) and sent reminders every two weeks to encourage participation and completion.

The investigator also distributed the survey through professional networks and official channels, including the heads of departments in each public hospital and the medical chiefs of private hospitals, either face-to-face or via WhatsApp®. Participants were also encouraged to share the questionnaire link with colleagues across both sectors to increase participation.

To reach clinicians who preferred paper-based surveys, hard copies were provided to the department heads of selected public hospitals who agreed to assist in distribution. The completed surveys were sealed in an envelope and

collected by the head of department or an appointed staff member, who then returned them directly to the primary investigator. Each returned hard copy was assigned a unique identifier code.

The survey link was additionally shared on social media platforms such as Twitter (X) and Instagram®, including reposts through professional medical accounts to maximise reach. To prevent duplicate participation, the “prevent multiple submissions” feature was activated in Qualtrics®. For hard copies, participants were asked whether they had already completed the online version before receiving the paper questionnaire.

3.2.3. Data collection and storage

Data were collected through two methods: an online platform (Qualtrics®) and paper questionnaires to allow broad participation across both private and public hospitals in Kuwait. The survey was initially open from July 9th to September 10th, 2023. However, due to a low response rate, the survey was extended by one month until October 10th, 2023. The primary investigator was responsible for handling the data.

Responses from the hard copies were manually entered by the primary investigator into a Microsoft Excel® sheet designed specifically for hard copy data entry. Each copy was assigned a unique code to track entries. Data entry was checked and verified against the hard copies by the primary investigator and by an independent academic researcher (FM) to validate data entry. After

all hard copy data had been entered and verified, the physical copies were destroyed.

All completed and partially completed online surveys were stored on the secure Qualtrics® platform and then exported to a Microsoft Excel® sheet. The stored data did not contain any participant-identifiable information. Data were stored on a secure cloud service, Microsoft Office 365® OneDrive, in accordance with the University of Strathclyde data handling policy.

3.2.4. Data analysis

3.2.4.1. Data processing and inclusion criteria for analysis

Data from Qualtrics® were exported, merged with the manually entered hard-copy data in Microsoft Excel®, and cleaned before analysis. The cleaning process involved noting incomplete responses (retained for analysis), removing duplicates, correcting entry errors (e.g., Arabic entries, spelling mistakes), standardising formats, and ensuring data consistency to prepare the data set for accurate analysis. Participants who agreed to participate but did not complete any questionnaire section were excluded from data analysis. All completed and partially completed (completed at least one of the four sections) questionnaires were included and analysed using IBM SPSS® version 28.0.

3.2.4.2. Demographic section analysis

Categorical variables (e.g. gender, workplace, level of practice, country of medical training) were summarised as frequencies and percentages.

Continuous variables (e.g., age and years of experience) were described using the mean and standard deviation (SD) or the median and interquartile range (IQR), depending on the data distribution.

3.2.4.3. Knowledge section analysis

Knowledge was assessed using ten MCQs derived from ACOG (2018) and the BNF. Each correct response received one point, giving a maximum possible score of 17 points. For multi-answer questions, partial credit was assigned for each correct choice, while 0.5 points were deducted for each incorrect option to increase the validity and reliability of the responses (Sanderson, 1975; Pollard, 1989; Haffejee *et al.*, 2014; Ndu *et al.*, 2016). Participants who selected only incorrect answers or chose “I don’t know” received zero.

For descriptive analysis, participants’ total knowledge scores were grouped into high, moderate, and low levels using Bloom’s cut-off, which classifies percentages scores into $\geq 80\%$ (high), 60–79% (moderate), and $< 60\%$ (low) (Table 3.2). This approach is a widely used method for classifying KAP results (Olum *et al.*, 2020; Alzahrani *et al.*, 2022; Ashebir *et al.*, 2022). The frequency and percentage of participants in each category were then calculated to show the distribution of knowledge levels (Table 3.2).

For inferential analysis, the total knowledge score (out of 17) was treated as a continuous variable. To ensure comparability with the attitude and practice sections, the knowledge scores were normalised to a 0-100% scale using the

formula $(\text{participant's score}/17) \times 100$, and the normalised values were used for all inferential analyses. Data normality was assessed using the Shapiro–Wilk test to determine whether to use parametric or nonparametric tests (see Section 3.2.4.5). Scores were summarised as mean (SD) or median (IQR) as appropriate. The categorical knowledge levels were used only for descriptive reporting, while the continuous (normalised) scores were used for all correlation and group comparison analyses.

3.2.4.4. Likert-scale scoring and analysis for attitude and practice

The attitude and practice sections of the questionnaire were assessed using a five-point Likert scale, ranging from 1 (strongly disagree/never) to 5 (strongly agree/always). The attitude section assessed levels of agreement with statements, while the practice section assessed the frequency of behaviours related to SAP prescribing. Some items were phrased negatively to minimise acquiescence bias, and these were reverse-coded so that higher scores consistently reflected a more positive attitude or better prescribing practice (Hinz *et al.*, 2007; Willits *et al.*, 2016).

For each respondent, the total score for each section was calculated by summing all item responses, with possible ranges of 12-60 for attitude and 14-70 for practice. Higher total scores represented more favourable attitudes or better practices regarding SAP (Ramli *et al.*, 2018; Andrade *et al.*, 2020).

To allow comparability between sections with different scoring ranges, all total scores were normalised to percentages using the following formula (Riccò *et al.*, 2017):

Normalised score (%)

$$= \left(\frac{\text{Participant Score} - \text{Minimum Possible Score}}{\text{Maximum Possible Score} - \text{Minimum Possible Score}} \right) \times 100$$

Normalisation converted all scores to a 0-100% scale, allowing direct comparison between respondents and across sections, and ensuring suitability for parametric analysis where normality assumptions were met. The normalised scores were therefore used for inferential analyses, including group comparisons and correlations with demographic characteristics.

For descriptive analysis, both the attitude and practice scores were categorised using Bloom's cut-off method, which classifies responses into three levels of categories. The frequency and percentage of participants within each category were calculated to show overall patterns across the sample. The combined classification for knowledge, attitude, and practice is shown in Table 3.2.

Table 3:2: Categories and classification criteria for knowledge, attitude, and practice scores

Section	Score range	Percentage range	Category
Knowledge	≥13.5	80-100%	High
	10.2-13.4	60-79%	Moderate
	<10.1	<60%	Low
Attitude	≥48	80-100%	Positive
	36-47	60-79%	Neutral
	<35	<60%	Negative
Practice	≥56	80-100%	Best
	42-55	60-79%	Adequate
	<41	<60%	Poor

Regarding the final section, participants were asked to rank the strategies from most suitable (1) to least suitable (5). A weighted points system was used to summarise ranking totals, with higher cumulative scores indicating higher perceived suitability.

3.2.4.5. Analysis of dependent and independent variables

The main dependent variables in this study were the normalised continuous scores of knowledge, attitude, and practice toward SAP. Each outcome was analysed independently in relation to demographic and professional covariates. Separate inferential tests were conducted for knowledge, attitude, and practice scores. The independent variables included demographic and professional characteristics such as gender, age, years of practice, level of practice, speciality (OB/GYN or anaesthesia), hospital type (public or private), and country of medical training.

All analyses were performed using IBM SPSS® version 28.0. Data normality for each continuous dependent variable was assessed using the Shapiro–Wilk

test to determine whether parametric or non-parametric tests were appropriate.

3.2.4.5.1.Group comparisons

To compare mean or median differences in KAP scores across demographic and professional groups, parametric or nonparametric tests were applied based on data distribution. For two-group comparisons (e.g., gender, hospital type), an independent-samples t-test (parametric) or Mann-Whitney U test (non-parametric) was used (Yan *et al.*, 2017; Schober *et al.*, 2020). For comparisons involving more than two groups (e.g., level of practice or country of training), one-way ANOVA (parametric) or the Kruskal-Wallis test (non-parametric) was applied (Yan *et al.*, 2017; Schober *et al.*, 2020). Homogeneity of variances for ANOVA was assessed using Levene's test. When overall group differences were statistically significant, Tukey's Honestly Significant Difference (HSD) post-hoc test was used to identify which specific subgroups differed significantly from each other. This method was chosen because it controls for Type I error when conducting multiple pairwise comparisons (Lee *et al.*, 2018).

3.2.4.5.2.Correlation analysis

To explore associations between continuous demographic variables (e.g., age, years of practice) and each KAP domain, correlation tests were selected based on data distribution. Pearson's correlation was used for normally distributed variables, and Spearman's rank correlation was used when normality was not met (Yan *et al.*, 2017; Schober *et al.*, 2020). Moreover, three separate pairwise

correlations were conducted between the KAP domains (knowledge with attitude, attitude with practice, and knowledge with practice) to assess whether higher knowledge and positive attitudes were correlated with better reported SAP prescribing practice.

3.2.4.5.3. Multivariable regression analysis

Multivariable linear regression was conducted to identify factors associated with each KAP domain. Firstly, three separate models, one for each dependent variable (knowledge, attitude, and practice), with all demographic and professional variables entered as independent predictors. Secondly, an additional linear regression analysis was performed using normalised knowledge and attitude scores as predictors of the normalised practice score to assess whether higher knowledge and positive attitudes translated into best SAP practice. Statistical significance was set at $p < 0.05$. Model assumptions (linearity, normality of residuals, homoscedasticity, and multicollinearity) were assessed before interpreting regression results.

3.3. Results

3.3.1. Demographics

A total of 168 respondents participated in the survey. Of these, 3 (1.8%) declined participation, and 42 (25.0%) did not progress beyond consent, resulting in their exclusion from the final analysis. Therefore, 123 valid responses were included; 95/123 (77.2%) were from the online survey, and 28/123 (22.8%) were from the paper-format survey. The overall response rate

was 123/1388 (8.9%). Among the included participants, 32 (26.0%) partially completed the questionnaire, while 91 (74.0%) completed it fully (Table 3.3).

Table 3:3: Demographic and professional characteristics of the study participants (n = 123)

Variable	N (%)
Age (Median, IQR)	39.0 (31 – 48)
Gender	
Male	52 (42.3)
Female	71 (57.7)
Speciality	
Obstetrician and gynaecologists	89 (72.3)
Anaesthetists	27 (22.0)
Other (OB/GYN Trainees)	7 (5.7)
Place of medical training	
Middle East*	93 (75.6)
Europe	19 (15.4)
North America	2 (1.6)
Asia	7 (5.7)
Other	2 (1.6)
Years of Experience (Median, IQR)	14.0 (7 – 22)
Workplace	
Public	97 (78.9)
Private	21 (17.1)
Both	5 (4.1)
Level of practice**	
Consultant	25 (20.3)
Fellow	1 (0.8)
Specialist	26 (21.1)
Registrar	40 (32.5)
Board	24 (19.5)
Trainee	7 (5.7)

**The Middle East includes Kuwait, Saudi Arabia, Egypt, Jordan, and neighbouring countries.*

***Levels of practice reflect Kuwait's clinical hierarchy: trainees are residents in early training, registrars are mid-level practitioners, specialists and consultants are senior physicians, and board-certified doctors have completed postgraduate speciality certification.*

3.3.2. Knowledge section

3.3.2.1. Awareness:

Out of 123 participants, 123 (100.0%) reported being aware of at least one clinical guideline for SAP. Among them, 73/123 (59.3%) were aware of their hospital's local guidelines, while 50/123 (40.7%) were aware of international guidelines. The most frequently cited international sources were the Royal College of Obstetrics and Gynaecology (RCOG) (2019) (UK), mentioned by 31/123 (25.2%), followed by the ACOG (2018) by 7/123 (5.7%), and the Society of Obstetricians and Gynaecologists of Canada (SOGC) (2018) by 3/123 (2.4%).

3.3.2.2. Preference:

When asked about which guideline they primarily follow in their daily clinical practice, the majority, 81/123 (65.9%), reported adherence to local guidelines, whereas 42/123 (34.1%) preferred international guidelines. Among those preferring international sources, the RCOG (2019) was the most preferred (16/81, 19.8%), followed by the ACOG (2018) (5/81, 6.2%).

3.3.2.3. Overall knowledge of the participants

The remaining ten questions assessed participants' knowledge of SAP. Based on Bloom's cut-off classification, 105 (85.4%) participants demonstrated a low level of knowledge ($\leq 10.1/17$), and 18 (14.6%) had a moderate level (10.2–13.4/17). No participant achieved a high knowledge level ($\geq 13.5/17$) (Table 3.4).

The overall mean knowledge score was 7.5 ± 2.7 (out of 17; 44.3%), with scores ranging from 1.5 to 13.0. Normality testing using the Shapiro–Wilk test ($p = 0.058$) confirmed that the data did not deviate significantly from normality; therefore, the mean (SD) was used for reporting. Overall, participants' knowledge of SAP was classified as low according to Bloom's cut-off criteria.

Table 3:4 Knowledge questions and the frequency of the selected option for each question (The correct answer is in bold)

Question N=123	Options	Response N (%)
<i>For the surgical procedures below, which require antimicrobial prophylaxis? (Please select all that are appropriate)</i>	Clean (without prosthetic)	25 (20.3)
	Clean (with prosthetic)	63 (51.2)
	Clean-contaminated	92 (74.8)
	Contaminated	83 (67.5)
	Dirty	70 (56.9)
	I don't know	8 (6.5)
<i>From the following procedures, which would you prescribe antibiotic prophylaxis for? (Please select all that are appropriate)</i>	Colporrhaphy	34 (27.6)
	D&C (without-pregnancy indication)	38 (30.9)
	Elective C-section	84 (68.3)
	Emergency C-section	101 (82.1)
	Endometrial biopsy	23 (18.7)
	Hysteroscopic procedures	28 (22.8)
	IUD	16 (13.0)
	Laparoscopic myomectomy	50 (40.7)
	Robotic hysterectomy	48 (39.0)
	D&C for abortion	67 (54.5)
	I don't know	10 (8.1)
<i>The number of doses of antibiotic prophylaxis is:</i>	One dose	78 (63.4)
	1-2 doses	34 (27.6)
	More than two doses	6 (4.9)

	I don't know	5 (4.1)
<i>The appropriate timing for administering surgical antibiotic prophylaxis is:</i>	More than 60 min before incision	44 (35.8)
	During surgery	5 (4.1)
	Post-surgery	4 (3.3)
	Less than 60 min before incision	68 (55.3)
	I don't know	2 (1.6)
<i>According to the ACOG guideline, the first-line antibiotic for surgical prophylaxis for obstetric and gynaecological surgery is:</i>	Co-amoxiclav	19 (15.4)
	Cefazolin	46 (37.4)
	Ceftriaxone	29 (23.6)
	Cefuroxime	13 (10.6)
	Gentamicin	0 (0)
	I don't know	16 (13.0)
<i>In the case of an immediate hypersensitivity reaction to penicillin, according to ACOG guidelines, the recommended antibiotic prophylaxis is:</i>	Clindamycin + cefazolin	19 (15.4)
	Clindamycin alone	40 (32.5)
	Gentamicin + metronidazole	16 (13)
	Vancomycin	28 (22.8)
	I don't know	20 (16.3)
<i>The appropriate timing to administer co-amoxiclav for C-section surgery is:</i>	Before surgery	61 (49.6)
	Before and after surgery	18 (14.6)
	During surgery, after clamping the cord	25 (20.3)

	I don't know	19 (15.4)
<i>The appropriate timing for administering metronidazole in case of suspected anaerobic infection is:</i>	A single dose before surgery	18 (14.6)
	Multiple doses post-surgery for up to 24 hours	30 (24.4)
	Multiple doses post-surgery for up to 3 days	60 (48.8)
	I don't know	15 (12.2)
<i>The appropriate duration of antibiotic prophylaxis is:</i>	A single dose.	56 (45.5)
	Up to 24 hours post-surgery	30 (24.4)
	Up to 48 hours post-surgery	14 (11.4)
	Up to 3 days post-surgery	20 (16.3)
	Up to 1-week post-surgery	1 (0.8)
	I don't know	2 (1.6)
<i>Antibiotic prophylaxis can contribute to the spread of antimicrobial resistance. Is this true?</i>	Yes	68 (55.3)
	No	35 (28.5)
	I don't know	20 (16.3)

3.3.2.4. Inferential statistics

3.3.2.4.1. Correlation analysis

Age was not significantly correlated with knowledge score ($r=0.165$, $p = 0.068$).

In contrast, years since graduation showed a weak but statistically significant positive correlation with knowledge score ($r = 0.212$, $p = 0.018$).

3.3.2.4.2. Independent samples t-test

Knowledge scores did not differ significantly between females (mean = 7.47 ± 2.78 , $n = 71$) and males (mean = 7.62 ± 2.61 , $n = 52$). $t(121) = -0.304$, $p = 0.762$. The mean difference of -0.15 (95% CI: -1.13 to 0.83) indicates no significant difference between groups.

3.3.2.4.3. One-way ANOVA

Medical Speciality: There was a statistically significant difference in knowledge scores across medical specialities ($F(2,120) = 5.094$, $p = 0.008$). Post-hoc analysis demonstrated that OB/GYN clinicians scored significantly higher than those classified under “other” specialities (mean difference = 2.54 , 95% CI: 0.10 to 4.98 , $p = 0.039$). Differences between OB/GYN and anaesthesiology, as well as between anaesthesiology and the “other” group, were not statistically significant.

Level of practice: There was a statistically significant difference across levels of practice ($F(4,118) = 2.954$, $p = 0.023$). Tukey’s post-hoc test identified a single significant difference: consultants had significantly higher knowledge

scores than trainees (mean difference = 3.40, 95% CI: 0.31 to 6.49, $p = 0.023$). No other pairwise comparisons reached statistical significance.

Continent of medical degree: There was a statistically significant difference by the region in which participants obtained their medical degree ($F(4,118) = 2.701$, $p = 0.034$). Post-hoc comparisons indicated that participants trained in Asia scored significantly higher than those trained in North America (mean difference = 6.00, 95% CI: 0.16 to 11.84, $p = 0.041$). Given the very small sample size of the North America group ($n = 2$), this finding should be interpreted with caution. No other comparisons between regions showed significant differences. Workplace sector (public, private, or both) was not significantly associated with knowledge scores ($F(2,120) = 1.598$, $p = 0.207$).

3.3.2.4.4. Multivariable linear regression analysis

A multivariable linear regression was conducted to examine factors associated with SAP knowledge scores. The model was statistically significant ($F(9,81) = 3.065$, $p = 0.003$) and explained 17.1% of the variance (adjusted $R^2 = 0.171$). Age was negatively associated with knowledge ($B = -0.154$, $p = 0.030$, 95% CI: -0.292 to -0.015). Years since graduation showed a positive association ($B = 0.156$, $p = 0.026$, 95% CI: 0.019 to 0.293). Speciality was also a significant predictor; clinicians working in OB/GYN had significantly higher scores than those in other specialities ($B = -1.415$, $p = 0.005$, 95% CI: -2.391 to -0.440) (Negative coefficient reflects SPSS coding; OB/GYN scored higher). Gender, the continent where the degree was obtained, workplace sector, level of

practice, and attitude score were not independently associated with knowledge after adjustment (Table 3.5).

Table 3:5: Multivariable linear regression of predictors of surgical antibiotic prophylaxis knowledge score

Factor (reference)	Group Mean	Beta-coefficient	95% CI	p-value
Age (years)	—	-0.15	-0.29 to -0.01	0.03
Years since graduation	—	0.15	0.01 to 0.29	0.02
Speciality (OB/GYN vs others)	OB/GYN: 7.97 Others: 6.38	-1.41	-2.39 to -0.44	0.00
Gender (male vs female)	Male: 7.62 Female: 7.46	-0.21	-1.46 to 1.05	0.75
Continent of degree (Middle East vs others)	Middle East: 7.66 Others: 7.13	-0.09	-0.75 to 0.56	0.78
Workplace (Public)	Public: 7.30 Private: 8.38	+0.93	-0.35 to 2.21	0.15
Level of practice (Consultant vs other)	Consultant: 8.83 Others: 7.18	-0.16	-0.63 to 0.30	0.48
Attitude score (normalised score)	—	+0.04	-0.05 to 0.13	0.36

Model statistics: $R^2 = 0.254$; Adjusted $R^2 = 0.171$; $F(9,81) = 3.065$, $p = 0.003$.

3.3.3. Attitude section

3.3.3.1. Descriptive analysis

A total of 103 out of 123 participants (83.7%) completed the attitude section of the questionnaire. The attitude section was measured using 12 Likert-scale statements (score range: 12-60). The summed Likert score was not normally distributed (Shapiro-Wilk $p = 0.025$). The overall median attitude score was 44.0 (IQR: 8), indicating generally neutral-to-positive attitudes toward SAP prescribing. Using Bloom's cut-off criteria, the majority of participants demonstrated a neutral attitude, with 67/103 (65.0%) scoring between 36 and

47. A further 29/103 (28.2%) had a positive attitude (≥ 48), while only 7/103 (6.8%) showed a negative attitude (< 35).

Across individual statements, most respondents strongly agreed that doctors should follow SAP guidelines for OB/GYN surgery, with 76/103 (73.8%) selecting “strongly agree”. Similarly, 63/103 (61.2%) strongly agreed that a single pre-operative SAP dose should be given within 60 minutes before incision. In contrast, fewer respondents endorsed incorrect statements: 46/103 (44.6%) strongly agreed that broad-spectrum antibiotics are preferable to narrow-spectrum agents (Figure 3.1).

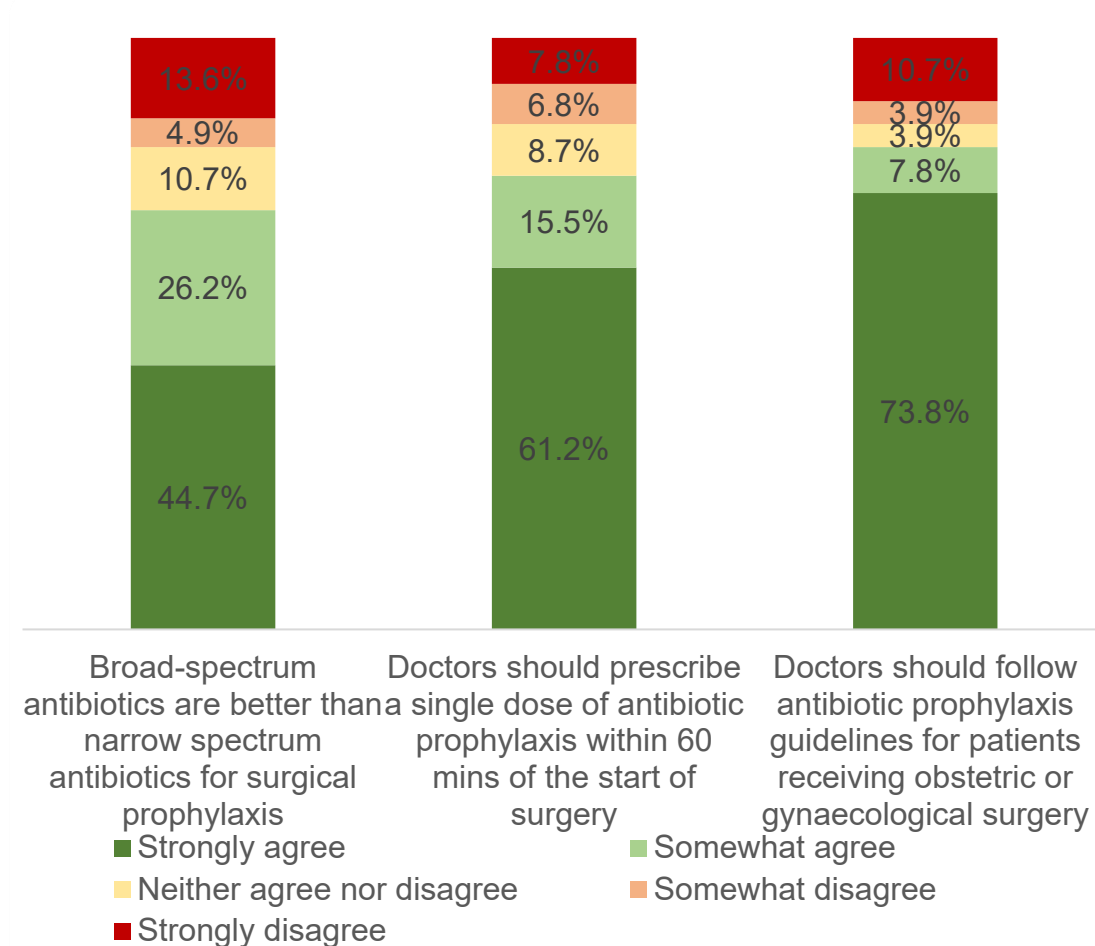


Figure 3.1: Response rate for statements 1 – 3 of the attitude section

Beliefs regarding operating theatre conditions were mixed. For the statement that operating theatres do not meet aseptic standards, 27 (26.2%) somewhat agreed, whereas 26 (25.2%) somewhat disagreed. Likewise, 34 (33.0%) somewhat agreed that staff fail to adhere to SAP prescribing protocols, while 18 (17.5%) strongly disagreed (Figure 3.2).

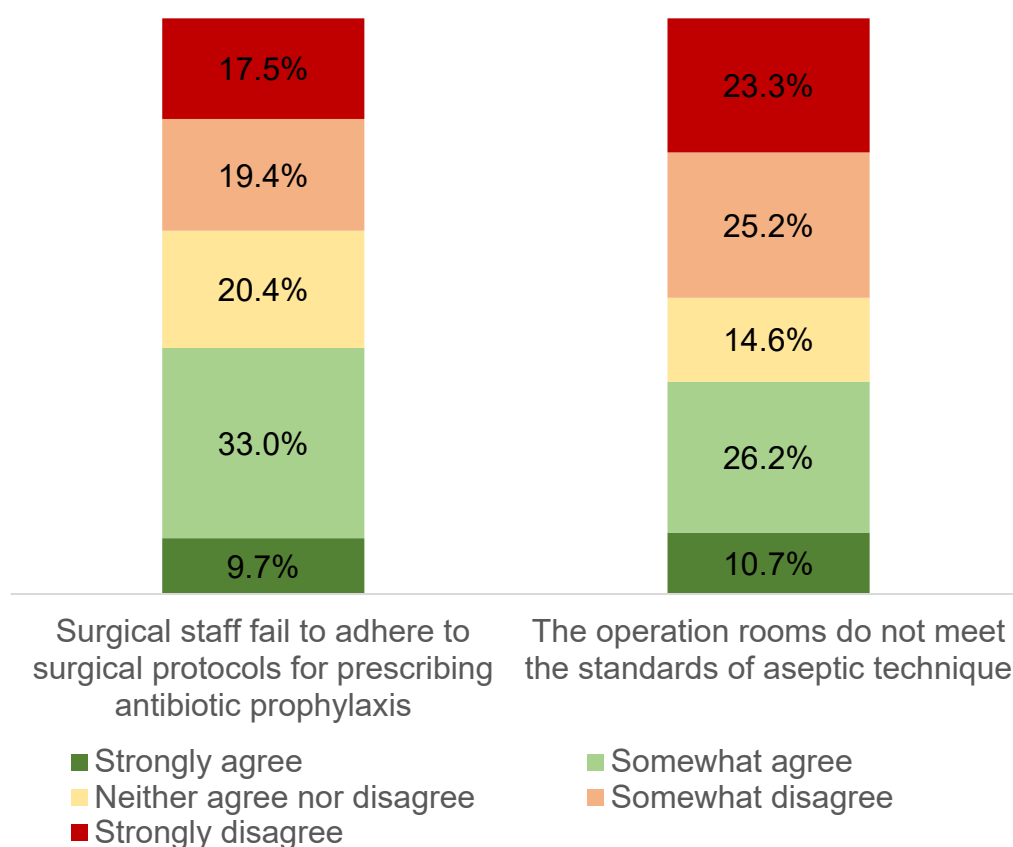


Figure 3.2: Response rate for statements 4 and 5 of the attitude section

Responses were also divided regarding the influence of patient hygiene on SAP duration, with 34/103 (33.0%) selecting either “somewhat agree” or “strongly agree”. For the statement on prolonging SAP to prevent SSIs, 33/103 (34.0%) somewhat disagreed, and 27/103 (26.2%) strongly disagreed. Most

participants, 41/103 (39.8%), strongly disagreed that SAP before caesarean section could cause long-term neonatal harm (Figure 3.3).

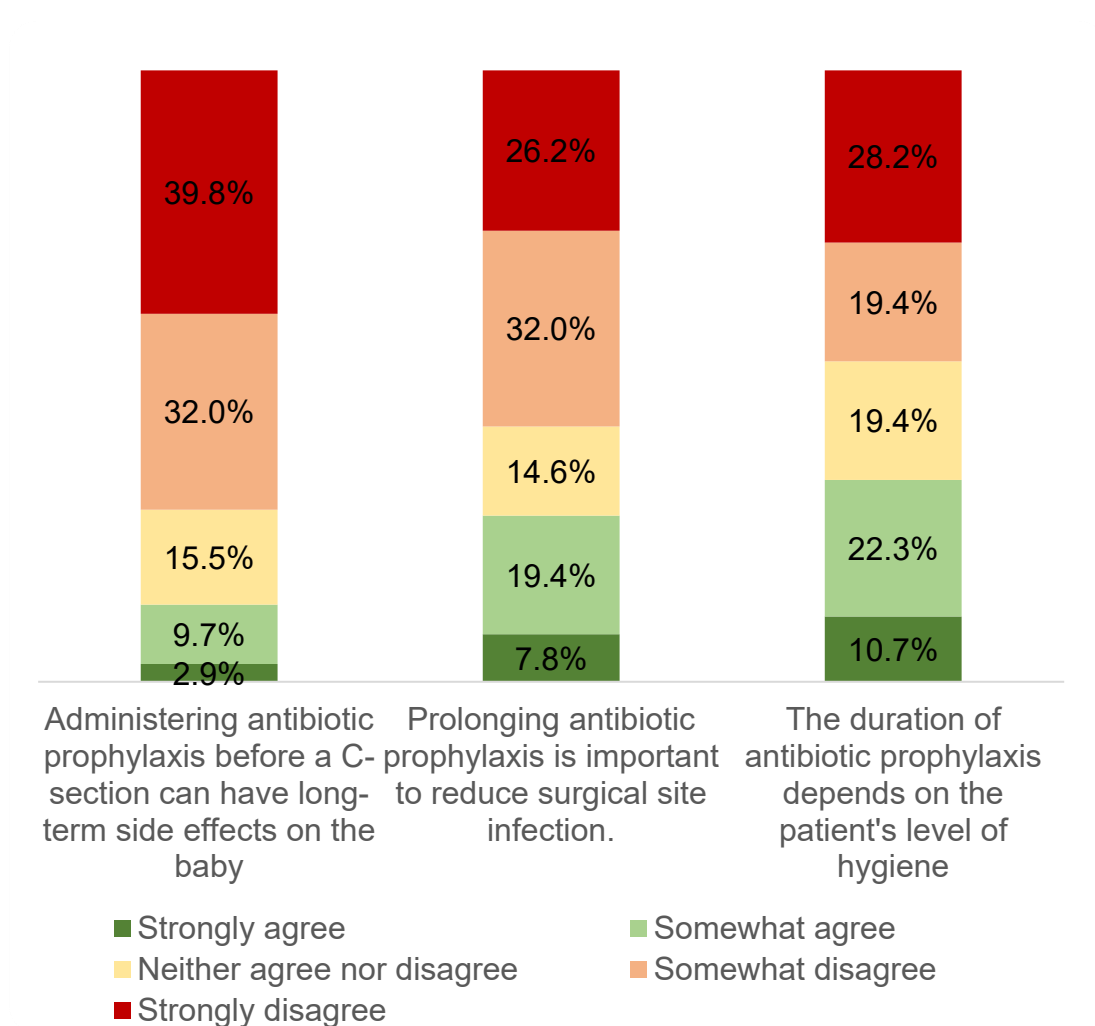


Figure 3.3: Response rate for statements 6 – 8 of the attitude section

Regarding clinical autonomy, 55/103 (53.4%) somewhat or strongly disagreed that doctors should not be restricted in selecting SAP type or duration, indicating a general preference for guideline-based rather than discretionary prescribing. There was strong recognition of the risks of inappropriate SAP, with 53/103 (51.5%) agreeing that misuse contributes to antimicrobial resistance (Figure 3.4).

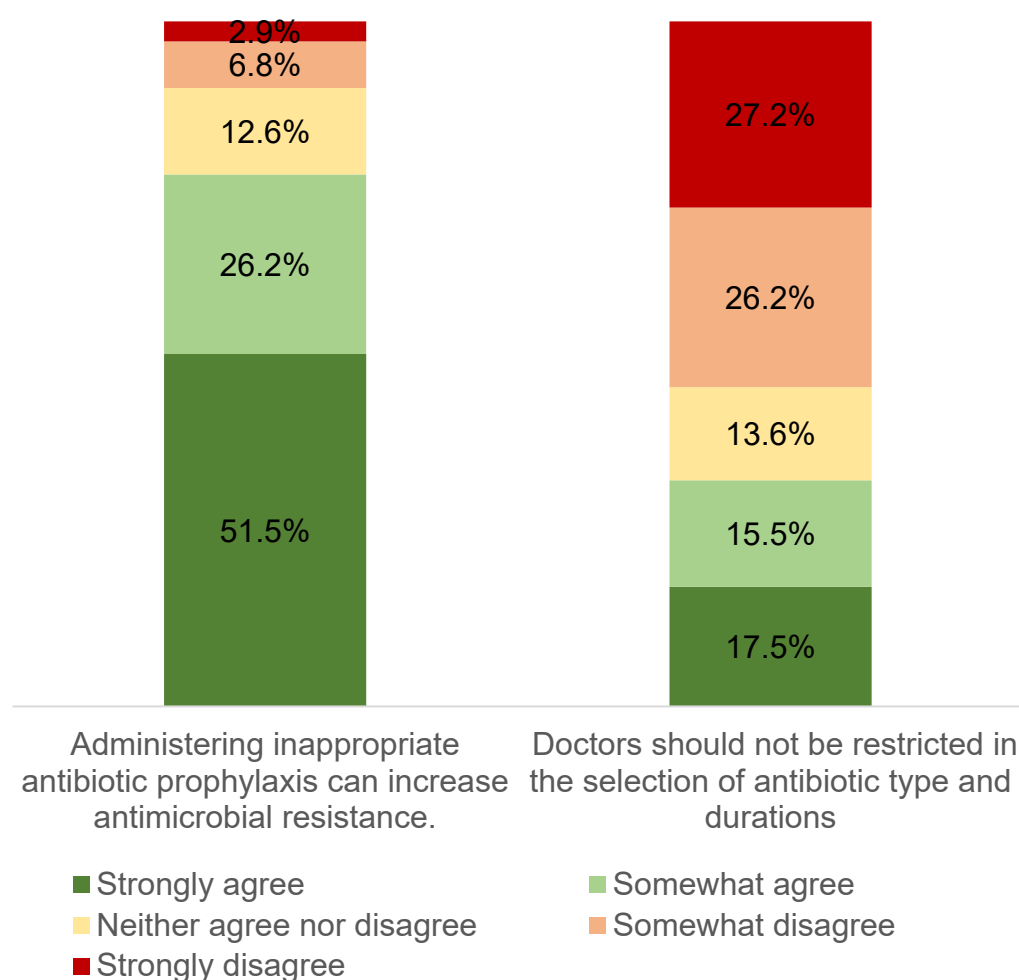


Figure 3.4: Response rate for statements 9 and 10 of the attitude section

Opinions on Kuwait's local SAP guidelines were mixed: 22/103 (21.4%) strongly disagreed that guidelines are outdated, whereas 24 (23.3%) somewhat agreed. However, there was near-total agreement that national standardisation is needed, with 79/103 (76.7%) strongly agreeing that Kuwait should establish a national SAP guideline (Figure 3.5). The median and IQR values for all attitude items are shown in Table 3.6.

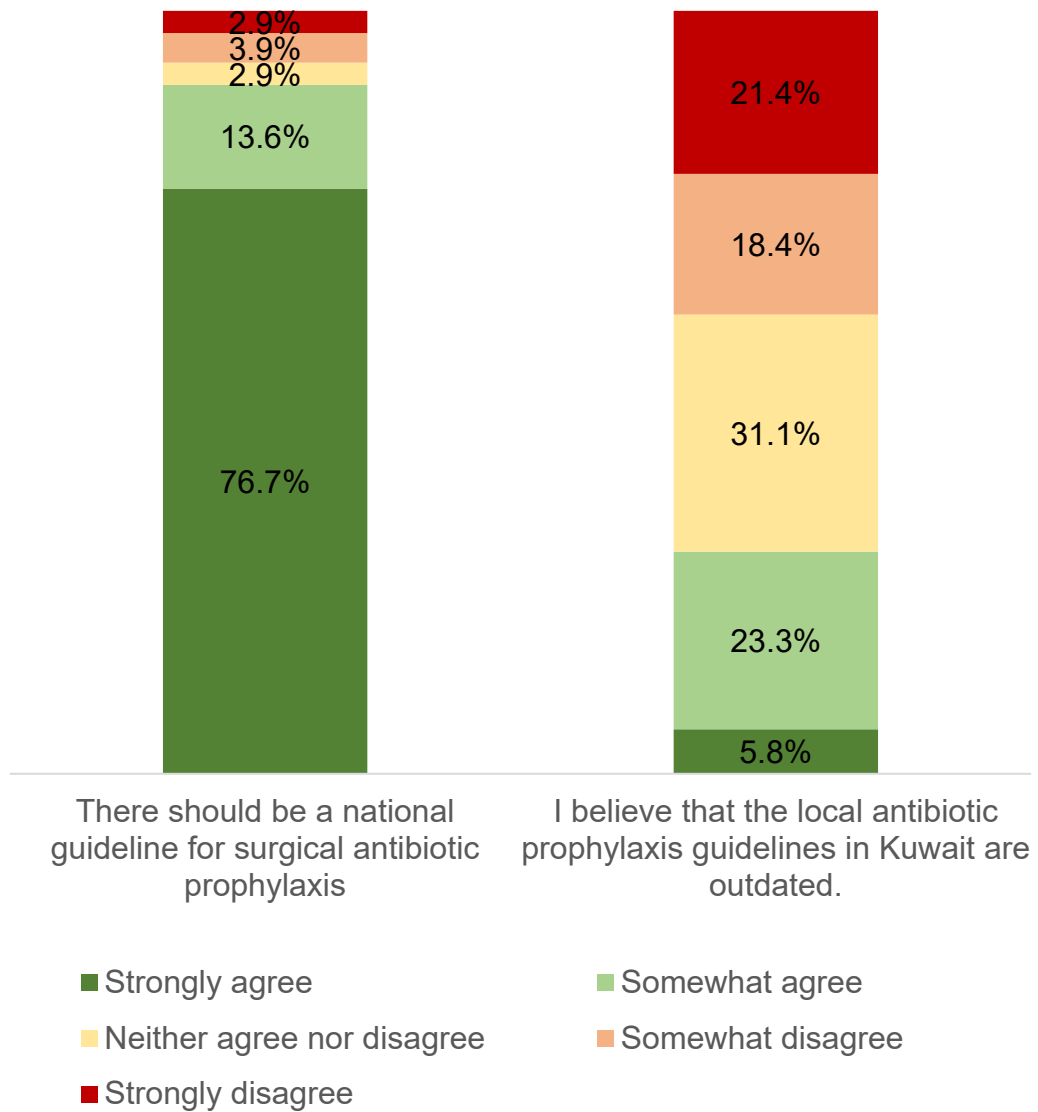


Figure 3.5 Response rate for statements 11 and 12 of the attitude section

Table 3:6: Attitude statements median and IQR. *Reverse-coded statement

Statement	Median	IQR
<i>Doctors should follow antibiotic prophylaxis guidelines for patients receiving obstetric or gynaecological surgery</i>	5.0	4 – 5
<i>Doctors should prescribe a single dose of antibiotic prophylaxis within 60 mins of the start of surgery</i>	5.0	4 – 5
<i>Broad-spectrum antibiotics are better than narrow spectrum antibiotics for surgical prophylaxis*</i>	2.0	1 – 3
<i>The operation rooms do not meet the standards of aseptic technique*</i>	3.0	2 – 4
<i>Surgical staff fail to adhere to surgical protocols for prescribing antibiotic prophylaxis*</i>	3.0	2 – 4
<i>The duration of antibiotic prophylaxis depends on the patient's level of hygiene*</i>	3.0	2 – 5
<i>Prolonging antibiotic prophylaxis is important to reduce surgical site infection. *</i>	4.0	2 – 5
<i>Administering antibiotic prophylaxis before a C-section can have long-term side effects on the baby*</i>	4.0	3 – 5
<i>Doctors should not be restricted in the selection of antibiotic type and durations*</i>	4.0	2 – 5
<i>Administering inappropriate antibiotic prophylaxis can increase antimicrobial resistance.</i>	5.0	4 – 5
<i>I believe that the local antibiotic prophylaxis guidelines in Kuwait are outdated. *</i>	3.0	2 – 4
<i>There should be a national guideline for surgical antibiotic prophylaxis</i>	5.0	5 – 5

3.3.3.2. Inferential analysis

3.3.3.2.1. Correlation analysis

There was no significant correlation between attitude score and age ($r_s = 0.077$, $p = 0.441$, $n = 103$), nor between attitude score and years since graduation ($r_s = 0.111$, $p = 0.262$, $n = 103$).

3.3.3.2.2.Mann–Whitney U test

There was no statistically significant difference between females ($n = 59$) and males ($n = 44$) ($U = 1268.5$, $p = 0.844$). The effect size ($r = 0.02$) was negligible, suggesting no meaningful gender-based differences in SAP attitudes.

3.3.3.2.3.Kruskal-Wallis test

Medical speciality: no significant difference in attitude scores among OB/GYN clinicians ($n = 73$), anaesthesiologists ($n = 23$), and the “other” group ($n = 7$) ($H(2) = 3.78$, $p = 0.151$). Although the “other” group had a higher mean rank, this difference was not statistically meaningful.

Level of practice: There was no statistically significant difference across levels of practice, consultants ($n = 24$), specialists ($n = 20$), registrars ($n = 34$), board-certified physicians ($n = 18$), and trainees ($n = 7$) ($H(4) = 7.77$, $p = 0.101$).

Region of medical training: Attitude scores did not differ significantly between clinicians trained in the Middle East ($n = 78$), Europe ($n = 15$), North America ($n = 2$), Asia ($n = 6$), or other regions ($n = 2$) ($H(4) = 5.55$, $p = 0.236$).

Workplace sector: no significant difference between clinicians working in public ($n = 83$), private ($n = 16$), or mixed ($n = 4$) sectors ($H(2) = 1.09$, $p = 0.580$).

3.3.3.3. Multivariable linear regression analysis

A multivariable linear regression analysis was conducted to examine factors associated with attitude scores. The analysis was performed using the normalised attitude score. The overall model was not statistically significant ($F(9, 81) = 1.77$, $p = 0.085$) and explained 7.2% of the variance in attitude scores (adjusted $R^2 = 0.07$). However, two variables showed statistically significant associations with attitude.

Clinicians working in OB/GYN reported significantly higher attitude scores compared with those in other specialities ($B = 5.10$, $p = 0.045$, 95% CI: 0.10 to 10.11). In addition, higher practice scores were independently associated with higher attitude scores ($B = 0.31$, $p = 0.029$, 95% CI: 0.03 to 0.59). No statistically significant associations were observed for gender, age, years since graduation, workplace sector, region of medical degree, level of practice, or knowledge score after adjustment. Full regression results are presented in Table 3.7.

Table 3:7: Multivariable linear regression examining factors associated with normalised attitude scores

Factors (reference)	Group Means	B	95% CI for B	p-value
Speciality (OB/GYN)	OB/GYN: 63.16 Others: 67.50	+5.10	0.10 - 10.11	0.04
Practice score (normalised score)		+0.31	0.03 - 0.59	0.03
Gender (male)	Female: 64.90 Male: 63.78	-1.36	-7.57 - 4.85	0.67
Age (years)		+0.20	-0.51 - 0.91	0.58
Years since graduation		+0.08	-0.62 - 0.77	0.83
Continent of degree (Middle East)	Middle East: 64.08 Other: 65.50	+1.20	-2.03 - 4.43	0.46
Workplace sector	Public: 64.99 Private: 63.67	-5.42	-11.69 - 0.85	0.09
Level of practice (Consultant)	Consultant: 63.72 Others: 64.63	+0.44	-1.86 - 2.74	0.71
Knowledge score (normalised score)		+0.09	-0.23 - 0.41	0.36

Model statistics: $R^2 = 0.165$, Adjusted $R^2 = 0.072$, $F(9,81) = 1.77$, $p = 0.085$.

3.3.4. Practice section

3.3.4.1. Descriptive analysis

A total of 91 (74.0%) out of 123 participants completed the practice section. The Shapiro-Wilk test indicated no evidence of non-normality ($p = 0.436$); therefore, the mean and standard deviation were used for descriptive reporting, and parametric tests were used for inferential analysis. The overall mean practice score was 49.8 ± 6.0 , with a median of 50.0 (IQR: 8) and scores ranging from 36 to 62. Using Bloom's cut-off criteria for SAP practice (poor <41, adequate 42–55, best ≥ 56), 30/91 (33.0%) participants demonstrated poor practice, 52/91 (57.1%) demonstrated adequate practice, and only 9/91 (9.9%) achieved best practice.

Many respondents believed that they were always (28/91, 30.8%) or most of the time (30/91, 33.0%) responsible for prescribing SAP for patients undergoing OB/GYN surgery. Half of the participants (46/91, 50.5%) reported always checking whether the patient received SAP before the procedure (Figure 3.6).

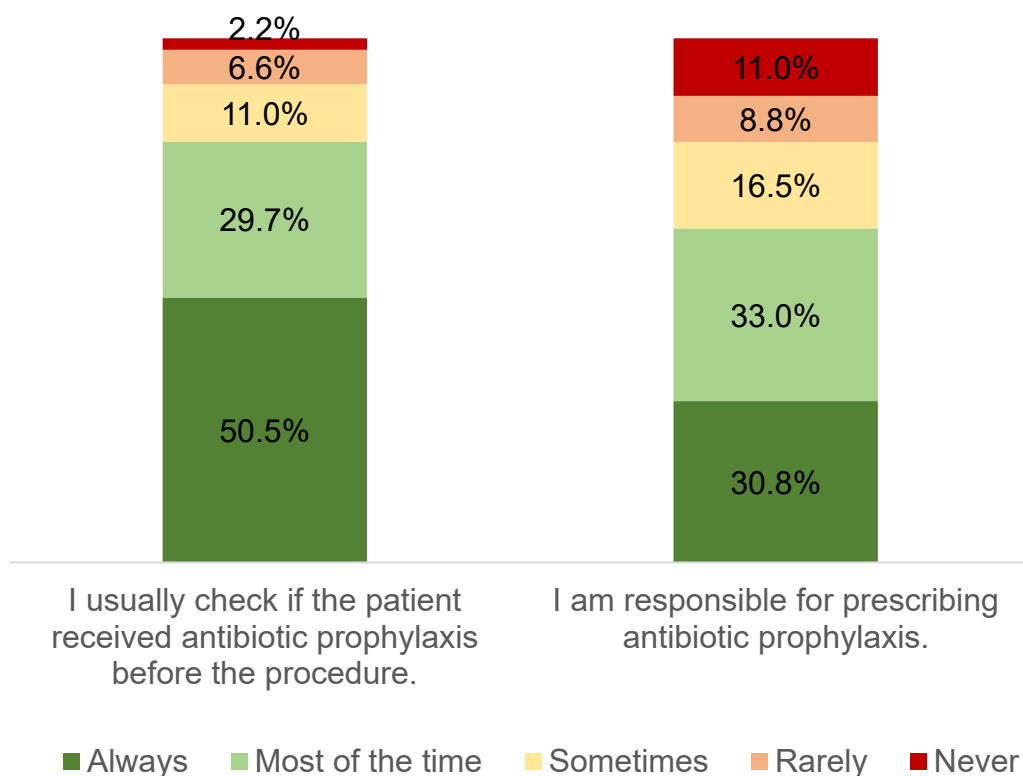


Figure 3.6: Response rate for statements 1 and 2 of the practice section

Less than half (39/91, 42.9%) stated that they always prescribe a single dose of SAP pre-operatively. Regarding combining anaerobic coverage with cephalosporins, 35/91 (38.5%) reported sometimes prescribing this combination. Documentation practices were generally consistent, with 44/91 (48.4%) always documenting SAP orders (Figure 3.7).

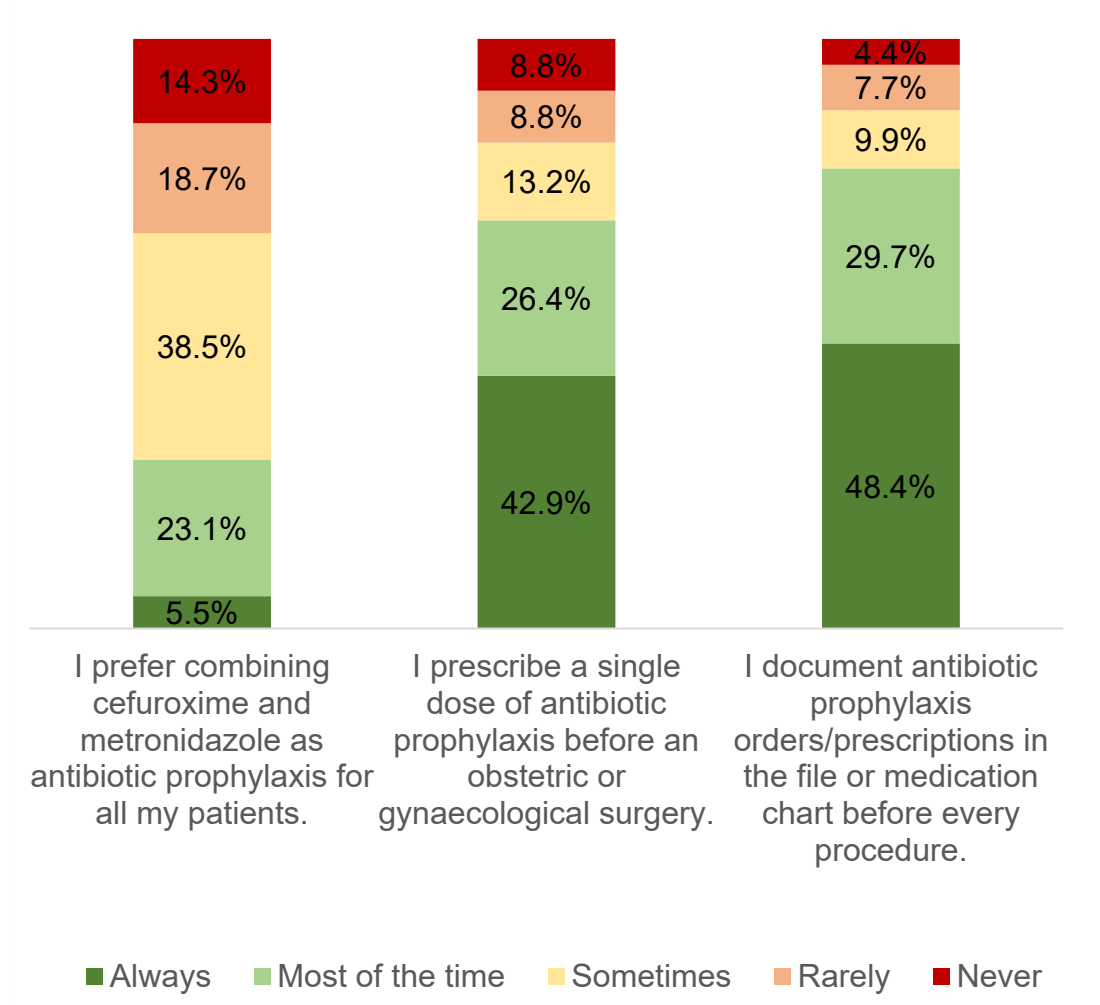


Figure 3.7: Response rate for statements 3-5 of the practice section

Post-operative SAP prescribing showed variation in practice, with participants reporting prescribing it sometimes (31/91, 34.1%) or always (22/91, 24.2%). Half (46/91, 50.5%) reported that they always document stop dates when prescribing post-operative antibiotics, and 48/91 (53.7%) always adhere to local hospital guidelines (Figure 3.8).

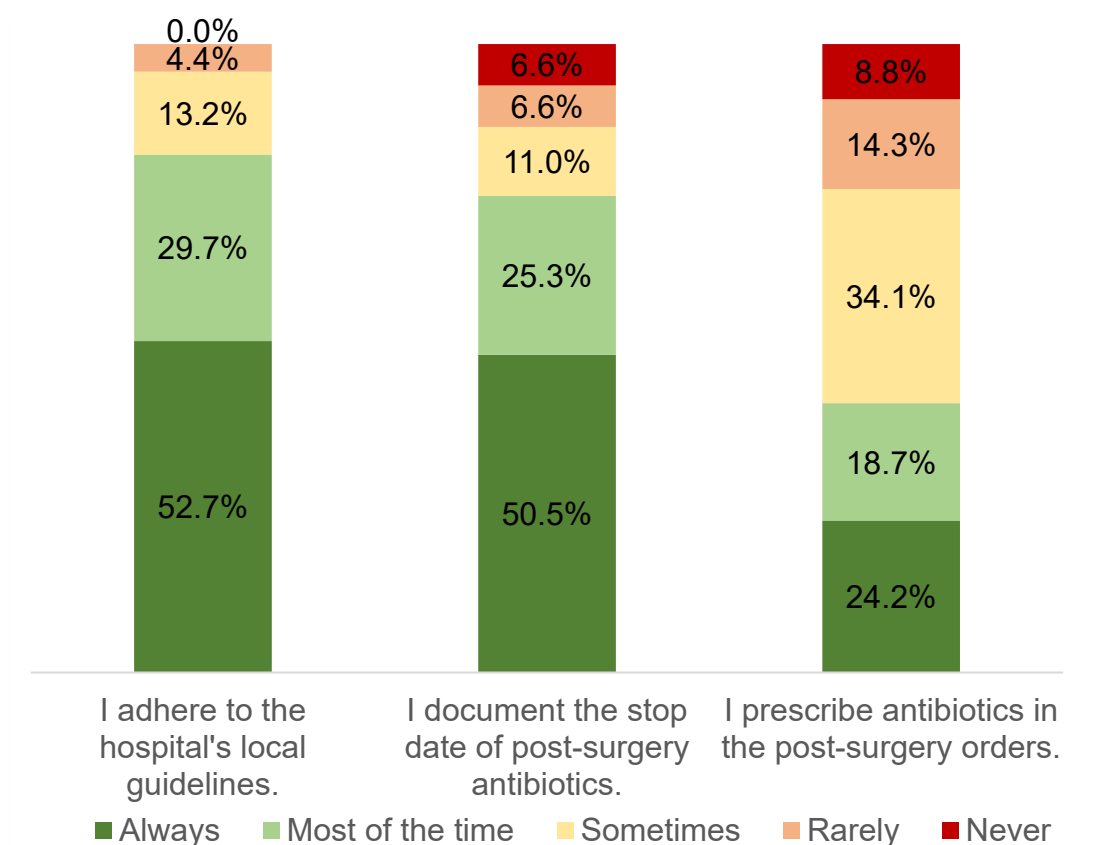


Figure 3.8: Response rate for statements 6-8 of the practice section

Most participants (51/91, 56.0%) reported that cost does not influence deviation from local guidelines. However, antibiotic availability did influence practice, as 35/91 (38.5%) sometimes deviated from guidelines when recommended agents were unavailable. Seniors were less influential, with 27/91 (29.3%) never deviating and 26/91 (28.6%) deviating sometimes (Figure 3.9).

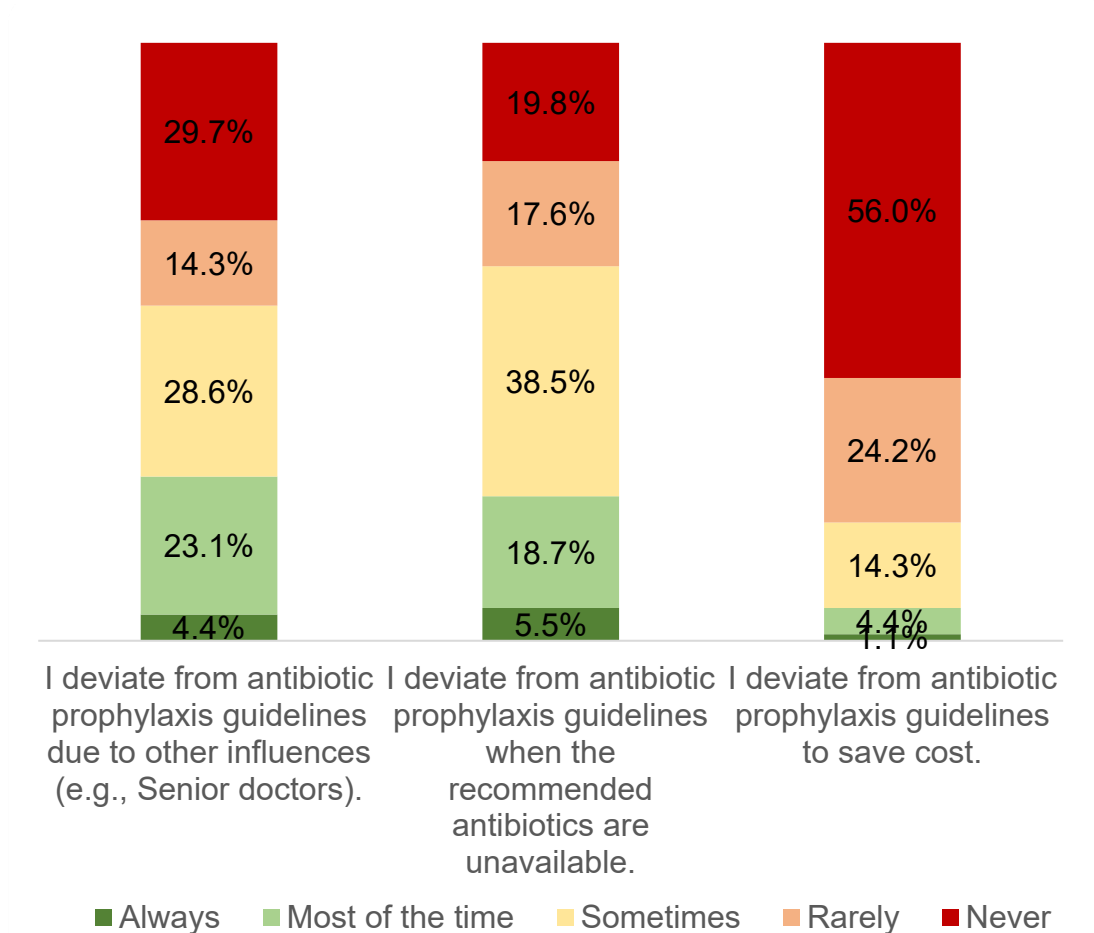


Figure 3.9: Response rate for statements 9 – 11 of the practice section

Consultation with pharmacists and microbiologists was variable. As 35/91 (38.5%) sometimes consulted pharmacists, and 22/91 (24.2%) rarely did so. Consultation with microbiologists was similarly limited, and 43/91 (47.3%) reported sometimes referring to external medical resources when prescribing SAP (Figure 3.10). Item-level medians and IQRs are presented in Table 3.8.

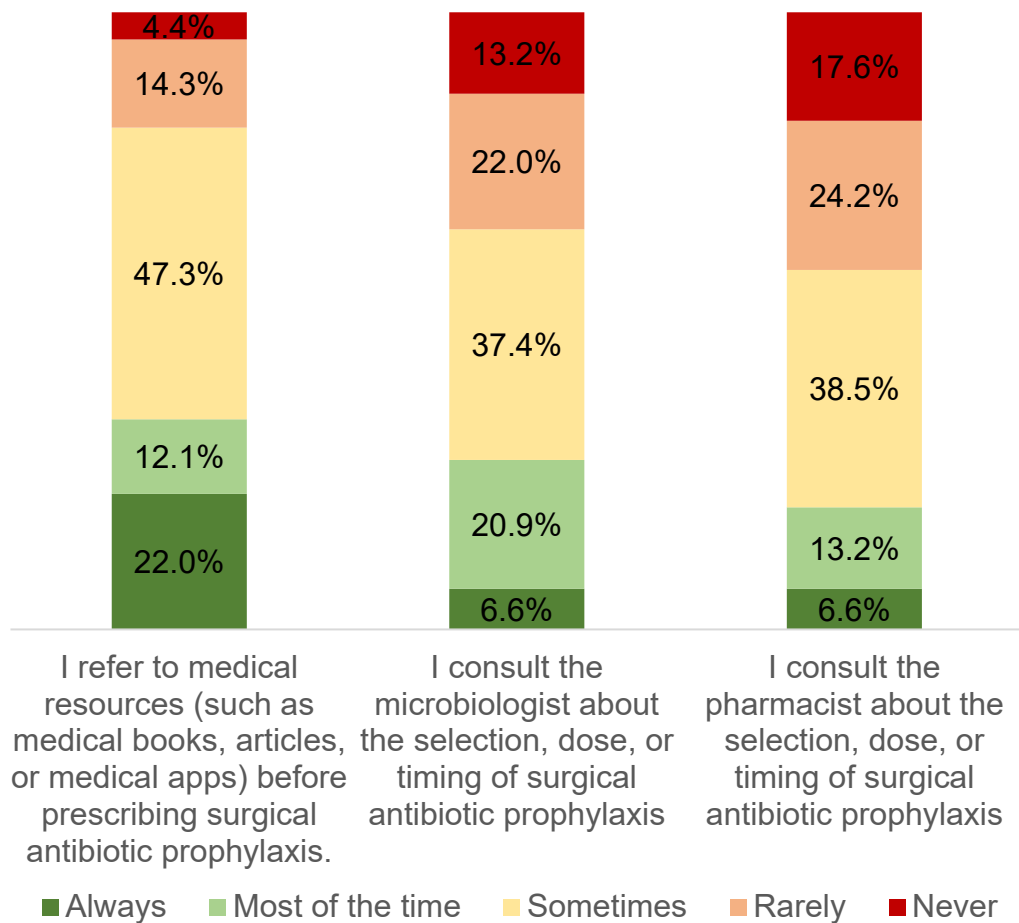


Figure 3.10: Response rate for statements 12 – 14 of the practice section

Table 3:8: Practice statements median and IQR

Statements	Median	IQR
<i>I am responsible for prescribing antibiotic prophylaxis.</i>	4	3 – 5
<i>I usually check if the patient received antibiotic prophylaxis before the procedure.</i>	5	4 – 5
<i>I prescribe a single dose of antibiotic prophylaxis before an obstetric or gynaecological surgery.</i>	4	3 – 5
<i>I prefer combining cefuroxime and metronidazole as antibiotic prophylaxis for all my patients.</i>	3	2 – 4
<i>I document antibiotic prophylaxis orders/prescriptions in the file or medication chart before every procedure.</i>	4	4 – 5
<i>I prescribe antibiotics in the post-surgery orders.</i>	3	2 – 3
<i>I document the stop date of post-surgery antibiotics.</i>	5	4 – 5
<i>I adhere to the hospital's local guidelines.</i>	5	4 – 5
<i>I deviate from antibiotic prophylaxis guidelines to save cost.</i>	5	4 – 5
<i>I deviate from antibiotic prophylaxis guidelines when the recommended antibiotics are unavailable.</i>	3	3 – 4
<i>I deviate from antibiotic prophylaxis guidelines due to other influences (e.g., Senior doctors).</i>	3	2 – 5
<i>I consult the pharmacist about the selection, dose, or timing of surgical antibiotic prophylaxis</i>	3	2 – 3
<i>I consult the microbiologist about the selection, dose, or timing of surgical antibiotic prophylaxis</i>	3	2 – 4
<i>I refer to medical resources (such as medical books, articles, or medical apps) before prescribing surgical antibiotic prophylaxis.</i>	3	3 – 4

3.3.4.2. Inferential analysis

3.3.4.2.1. Pearson correlation analysis

There was no statistically significant correlation between practice and age ($r = 0.185$, $p = 0.080$, $n = 91$) or years since graduation ($r = 0.160$, $p = 0.130$, $n = 91$). In contrast, practice score showed a statistically significant positive correlation with attitude score ($r = 0.284$, $p = 0.006$, $n = 91$) and knowledge score ($r = 0.230$, $p = 0.028$, $n = 91$).

3.3.4.2.2.Independent sample t-test

An independent samples t-test examined differences in practice scores between females ($n = 51$) and males ($n = 40$). There was no statistically significant difference between the two groups ($t(89) = 0.898$, $p = 0.372$).

Females had a mean score of 50.33 ± 6.06 , whereas males had a mean score of 49.20 ± 5.86 , with a mean difference of 1.13 (95% CI: -1.37 to 3.64). The effect size was small (Cohen's $d = 0.19$).

3.3.4.2.3.One-way ANOVA

Medical speciality: There was no statistically significant difference in practice scores between OB/GYN clinicians ($n = 65$), anaesthesiologists ($n = 19$), and participants from other specialities ($n = 7$) ($F(2,88) = 0.076$, $p = 0.927$). Post hoc comparisons revealed no statistically significant pairwise differences.

Level of practice: Practice scores did not differ significantly between consultants ($n = 21$), specialists ($n = 17$), registrars ($n = 30$), board-certified clinicians ($n = 16$), and trainees ($n = 7$) ($F(4,86) = 0.640$, $p = 0.635$). Tukey's post-hoc test revealed no meaningful differences between any groups.

Region of medical degree: There was no statistically significant difference in practice scores across clinicians trained in the Middle East ($n = 69$), Europe ($n = 14$), North America ($n = 2$), Asia ($n = 5$), or other regions ($n = 1$) ($F(4,86) = 0.302$, $p = 0.876$). Given the extremely small sample sizes in some subgroups (e.g., North America $n=2$), all comparisons should be interpreted with caution.

Workplace sector: there was no significant difference between clinicians working in public (n = 75), private (n = 13), or both sectors (n = 3) settings ($F(2,88) = 2.833$, $p = 0.064$). Although clinicians working across both sectors had a higher mean score (57.67), post-hoc comparisons were not statistically significant.

3.3.4.3. Multivariable linear regression analysis

A multivariable linear regression analysis was conducted to examine factors associated with SAP practice (normalised) scores. The overall model was statistically significant ($F(9, 81) = 2.19$, $p = 0.031$), explaining 10.6% of the variance in practice scores (adjusted $R^2 = 0.106$). Normalised attitude score was the only factor independently associated with practice, where higher attitude scores were significantly associated with higher practice scores ($B = 0.19$, $p = 0.029$, 95% CI: 0.02 to 0.35). All other predictors, including knowledge score, gender, age, years since graduation, speciality, workplace sector, region of medical training, and level of practice, were not independently associated with practice score after adjustment (Table 3.9).

Table 3:9: Multivariable linear regression examining factors associated with SAP practice scores

Factors (reference)	Group mean	B	95% CI	p-value
Attitude score (normalised)	—	+ 0.19	0.02 - 0.35	0.03
Knowledge score (normalised)	—	+0.13	-0.01 - 0.28	0.07
Gender (female vs male)	Female: 64.88 Male: 62.86	-3.78	-9.01 - 1.45	0.12
Age (years)	—	+0.37	-0.18 - 0.93	0.18
Years since graduation	—	-0.08	-0.62 - 0.47	0.78
Speciality (OB/GYN vs others)	Middle East: 63.72 Others: 64.11	+0.65	-3.30 - 4.59	0.75
Continent of degree (Middle East vs others)	Middle East: 63.72 Others: 64.11	-0.28	-2.83 - 2.26	0.83
Workplace sector (public vs others)	Public: 63.67 Others: 65.30	+1.68	-3.32 - 6.69	0.51
Level of practice (consultant vs others)	Consultant: 65.48 Others: 62.99	+1.46	-0.34 - 3.24	0.11
<i>Model statistics: $R^2 = 0.196$; Adjusted $R^2 = 0.106$; $F(9,81) = 2.189$; $p = 0.031$</i>				

3.3.5. The overall relationship between knowledge, attitude and practice

3.3.5.1. Correlation analysis

Knowledge with attitude: There was a weak positive correlation between knowledge and attitude scores; however, it was not statistically significant ($r = 0.07$, $p = 0.478$, $n = 103$).

Knowledge with practice: There was a statistically significant, low, positive correlation between knowledge and practice scores ($r = 0.23$, $p = 0.028$, $n = 91$), suggesting that clinicians with higher knowledge tended to demonstrate better SAP prescribing practices.

Attitude with practice: There was a statistically significant moderate, positive correlation between attitude and practice scores ($r = 0.28$, $p = 0.006$, $n = 91$). Clinicians with positive attitudes were more likely to demonstrate better SAP practice.

3.3.6. The most important strategy to optimise SAP prescribing in Kuwait

In the final section of the questionnaire, participants ranked five predefined strategies for optimising SAP prescribing in Kuwait from most important (1) to least important (5). Developing a national SAP guideline received the highest total score (339 points), indicating it was viewed as the most important strategy to improve SAP practice. Staff training and education was ranked second (327 points), followed by audit and feedback from clinical pharmacists (239 points). Antimicrobial stewardship programme implementation (231 points) and conducting local research (229 points) received lower, but comparable scores. (Figure 3.11).

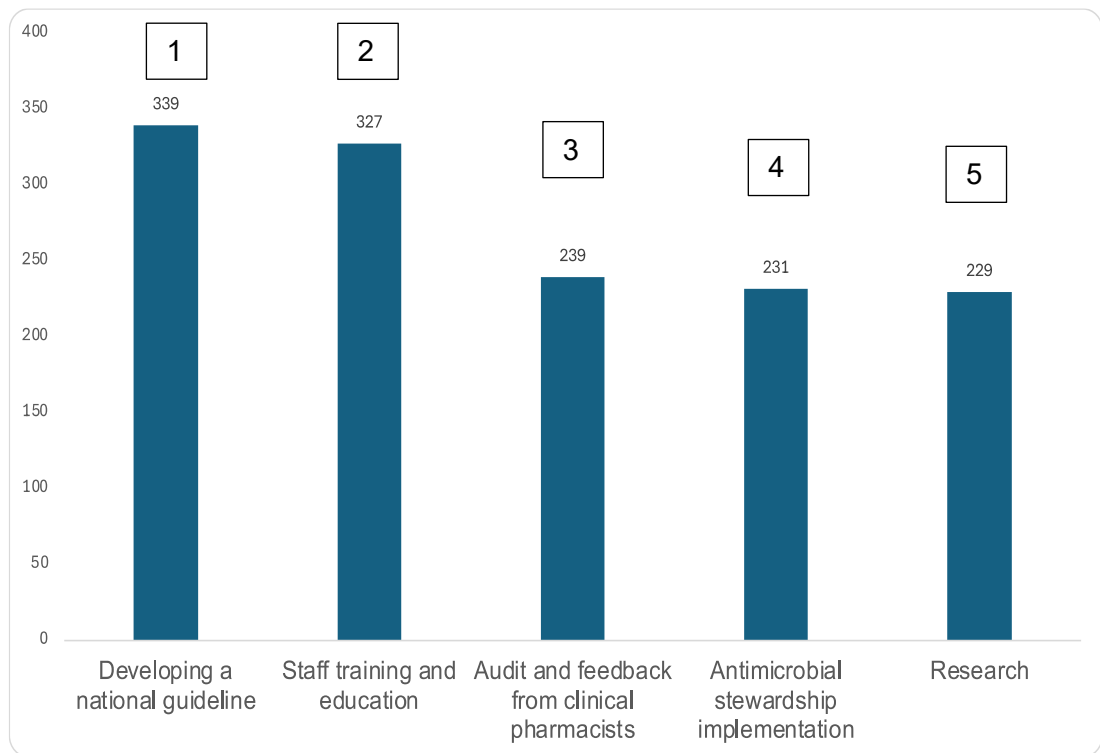


Figure 3.11: Ranking of the most important strategies to improve SAP practice in Kuwait, with the highest points representing the most important strategy.

3.4. Discussion

3.4.1. Overview

This study assessed the overall knowledge, attitudes, and practice of OB/GYNs and anaesthetists in public and private hospitals in Kuwait regarding SAP. It aimed to determine whether prescribers have the knowledge to appropriately prescribe SAP and to identify knowledge gaps regarding its optimal use in OB/GYN procedures. Additionally, the survey explored doctor's attitudes and beliefs towards SAP guidelines and how these align with their daily practice.

Given the absence of national SAP guidelines in Kuwait, the study further investigated clinicians' awareness and utilisation of international guidance, particularly American OB/GYN guidelines, which are frequently consulted in Kuwaiti practice (Alhajji *et al.*, 2020; Torumkuney *et al.*, 2022). This survey provided a unique opportunity to determine the preferred guidelines of local prescribers, which could serve as a foundation for developing interventions and recommendations tailored to Kuwaiti clinical practice. The final objective of this study was to highlight areas for improvement in antibiotic prescribing for surgical prophylaxis in Kuwait and to identify factors associated with a high level of knowledge, a positive attitude, and adherence to best practice in SAP among OB/GYN surgeons and anaesthetists in Kuwait.

3.4.2. Key findings

3.4.2.1. Summary of key findings:

The study identified consistent gaps in clinicians' knowledge, attitude and practice regarding SAP. Overall knowledge levels were low, indicating limited familiarity with key elements of appropriate SAP prescribing. Attitude towards SAP guidelines was predominantly neutral, suggesting varied beliefs about their relevance, applicability, and practicality in the Kuwaiti context. Although the overall practice was classified as adequate, several gaps remained, suggesting the need to strengthen and standardise SAP prescribing practices across hospitals in Kuwait (Table 3.2).

The analysis of associated factors showed that demographic and professional characteristics had a limited influence on clinicians' SAP prescribing practice. Knowledge varied by years since graduation, medical speciality and the region of medical training. Similarly, attitude was associated with speciality and practice but showed no consistent relationship with demographic factors. This suggests that gaps in SAP knowledge and behaviour were prevalent among all clinician groups and were not limited to specific subpopulations.

The findings from the overall domains correlation and multivariate regression model showed that both knowledge and attitude were associated with best practice. Clinicians with higher knowledge and a positive attitude were more likely to report the best prescribing practice. In the multivariate model, attitude remained the strongest independent predictor of practice, while knowledge

showed a borderline association. This indicates that improving clinicians' confidence, motivation, and perception of guidelines' usefulness, along with targeted educational interventions to address knowledge gaps, may improve prescribing practices in Kuwait. Overall, efforts to improve prescribing practice should focus on system-level strategies, such as developing national guidelines, improving their accessibility and implementation, and providing a structured training program across all hospitals.

3.4.3. Interpretation of the results

3.4.3.1. Guideline awareness and preference:

Overall, the participants were more familiar with local guidelines than international ones. Based on routine practice in Kuwait, it was initially expected that OB/GYN departments would primarily follow American (ACOG, 2018) or Canadian (SOGC, 2018) guidelines, a pattern also observed in other specialities in Kuwait, such as internal medicine, which tends to follow American guidelines (Alhajji *et al.*, 2020). However, the survey showed that some participants had greater awareness of the RCOG guidelines, a UK-based standard, than of the ACOG (2018) or SOGC (2018) guidelines. Although the survey did not collect data on postgraduate training location, the common RCOG (2019) awareness among participants may reflect the influence of UK-based medical education or specialisation training. This familiarity with RCOG may explain why several local hospital guidelines and prescribing practices closely resemble RCOG (2019) recommendations, as shown in Chapter 2, Section 2.3.3.3, where cefuroxime was frequently used

as initial prophylaxis rather than cefazolin, as recommended by the ACOG (2018) guideline.

When asked about the guidelines they preferred in their daily practice, most participants reported favouring local rather than international guidelines. This could show that local clinical conditions, healthcare models, and legal or cultural practices in Kuwait likely influence these preferences (Francke *et al.*, 2008). For example, the frequent use of metronidazole combined with cefuroxime in OB/GYN surgery reflects local concern or beliefs about common anaerobic wound infections rather than strict adherence to international guidelines (Jamal *et al.*, 2010). Participants' preference for local guidelines may also be related to their perceived adaptability to Kuwait's patient population, workflow, and resources. This finding is consistent with previous studies showing that clinicians prefer guidelines that reflect their practice and environment (Davari *et al.*, 2018). At the same time, variation in guideline preferences among participants was observed, with some reporting a preference for international guidelines such as RCOG (2019) and ACOG (2018). This variation of guideline preferences highlights the lack of standardisation in SAP practice across Kuwait (Awad *et al.*, 2010; Torumkuney *et al.*, 2022).

3.4.3.2. Knowledge:

Overall SAP knowledge among participants was low, with OB/GYN clinicians demonstrating higher knowledge than anaesthetists. This likely reflects their

direct responsibility for perioperative decision-making and the greater frequency with which OB/GYN clinicians prescribe SAP. While years of experience and higher levels of practice were associated with greater knowledge, clinicians' age was negatively associated with the knowledge score. This could suggest that younger or more recently trained clinicians are more familiar with current international SAP recommendations, particularly within Kuwait's diverse medical workforce trained in regions with varying practice of SAP. Together, these findings indicate that active clinical engagement, rather than chronological age, may be a more influential determinant of SAP knowledge.

International evidence on clinicians' SAP knowledge is limited, but similar patterns of knowledge gaps have been reported in other settings. For example, Ahmed *et al.* (2019) in Sudan, low SAP knowledge among surgical staff, and Abubakar *et al.* (2020) reported poor SAP knowledge among OB/GYN clinicians in Nigeria. Although these studies were conducted in low-income settings, they remain among the few available studies that directly evaluate clinicians' SAP knowledge. However, their findings can show that uncertainty regarding SAP selection, timing and duration is common across different healthcare systems, regardless of resource level.

Significant confusion was observed regarding SAP requirements for specific surgical wound classifications. While most respondents (74.8%) correctly identified the need for SAP in clean-contaminated surgery, 20.3% incorrectly

believed SAP was required for clean surgery without prosthetics. This misconception contradicts the clear recommendations from the RCOG (2019), ACOG (2018), or the Scottish Intercollegiate Guidelines Network (SIGN) (2014). Conversely, nearly half (49%) failed to identify the need for SAP in clean-with-prosthetics surgery, which carries a high risk of postoperative infection (S. Shrestha, 2021; Sartelli *et al.*, 2021). These findings suggest insufficient awareness of guideline distinctions, possible overuse of antibiotics as a precautionary measure, and a lack of clarity between clean and clean-contaminated procedures. Contributing factors may include poor dissemination of guidelines, infrequent updates, and institutional culture favouring “extra safety.” Similar misclassification issues have been reported elsewhere (Levy *et al.*, 2015; Stefanou *et al.*, 2020), reinforcing the link between knowledge gaps and inconsistent prescribing practices. Overprescribing of SAP in clean surgery can lead to increased antimicrobial resistance (AMR), higher cost and drug adverse events (Branch-Elliman *et al.*, 2019). Evidence shows that targeted educational interventions, audit and feedback, and clearer dissemination of guidelines may improve clinicians’ awareness of SAP eligibility based on surgical wound classification (Fullington *et al.*, 2023).

Knowledge of procedures requiring SAP was also suboptimal. While emergency and elective C-sections had the highest recognition, likely reflecting their frequency in OB/GYN practice, awareness for less common procedures, such as colporrhaphy (27.6%) and robotic hysterectomy (39.0%),

was markedly lower, despite clear ACOG (2018) recommendations. This might suggest that clinicians' familiarity with SAP requirements is influenced by the frequency of performed procedures and perceived infection risk. The uncertainty regarding SAP for elective C-sections may reflect a misconception that elective procedures carry a lower infection risk compared to emergency cases (Hannah, 2004; Darnal *et al.*, 2020; Shehta Said Farag *et al.*, 2023), rather than adherence to guidelines. Contributing factors may include a lack of clear guidelines regarding the procedures requiring SAP. Moreover, variability of local protocols and reliance on habitual or senior influences. Similar gaps have been reported in other settings, where clinicians showed better knowledge for common procedures but poor awareness regarding less frequent procedures (Ahmed *et al.*, 2019; Abubakar *et al.*, 2020). These findings highlight the importance of targeted educational interventions and clear guidelines to ensure consistent SAP prescribing across all OB/GYN procedures.

Important gaps were also evident regarding SAP dose and timing. Although 63.4% of participants correctly identified that a single dose is appropriate, nearly one-third believed multiple doses were required or were unsure. Similarly, only 55.3% recognised the correct timing of SAP administration within 60 minutes prior to incision, while 35.8% incorrectly believed it should be administered earlier. These findings suggest persistent misconceptions about optimal SAP timing and dosing, which are critical for preventing SSI. Several factors may contribute to this, including poor dissemination of clear

guidelines, poor SAP training, or disrupted workflows for administering SAP at the correct time. Previous research demonstrates that incorrect timing significantly increases SSI risk (Classen *et al.*, 1992; Dhole *et al.*, 2023), while appropriate dosing and timing are strongly associated with improved surgical outcomes (Carter *et al.*, 2017; de Jonge *et al.*, 2017a; Dhole *et al.*, 2023). Similar gaps have been reported in other settings, such as Sudan, where 65% of clinicians lacked knowledge of correct timing (Ahmed *et al.*, 2019), indicating that this issue is widespread rather than context-specific.

The knowledge gap regarding the choice of first-line SAP observed in Kuwait mirrors findings from other international KAP studies, underscoring a global challenge in antibiotic selection. In this study, only 37.4% of respondents correctly identified cefazolin as the recommended first-line agent, while nearly one-quarter (23.6%) incorrectly chose broad-spectrum antibiotics such as ceftriaxone. This tendency to favour broader coverage, possibly due to misconceptions that broad-spectrum agents offer superior protection against SSIs, despite evidence that such practices increase AMR and adverse effects (Branch-Elliman *et al.*, 2019). This pattern of inappropriate preference for broad-spectrum agents has been reported elsewhere. For example, Abubakar *et al.* (2020) in Nigeria found that most OB/GYN clinicians lacked awareness of the correct antibiotic choice, with many favouring broad-spectrum options despite guideline recommendations. Similarly, Ahmed *et al.* (2019) in Sudan reported extremely low knowledge levels, with only 13% of participants correctly identifying the appropriate first-line antibiotic according to ASHP

guidelines. These findings collectively indicate that uncertainty regarding antibiotic selection persists across diverse healthcare settings, driven by misconceptions that broader coverage offers superior protection. This global trend highlights the urgent need for targeted educational interventions, regular dissemination of updated guidelines, and antimicrobial stewardship programs to promote evidence-based antibiotic selection and reduce unnecessary use of broad-spectrum agents.

Knowledge related to C-section-specific SAP recommendations was also inadequate. Only 20.3% correctly identified the timing of co-amoxiclav administration post-cord clamping to avoid neonatal necrotising enterocolitis (Kenyon *et al.*, 2013). The gaps mirror findings of Ahmed *et al.* (2019) where only 35.4% of respondents identified the correct timing. Similarly, only 14.6% recognised the need for a single pre-operative metronidazole dose, and just 45.5% correctly identified the appropriate SAP duration, lower than findings reported in Sudan (Ahmed *et al.*, 2019). Although SAP for up to 24 hours post-surgery may be recommended for specific procedures, it is typically reserved for cardiac and vascular surgeries or high-risk cases such as those involving obese patients (World Health Organization, 2018a). The persistence of these misconceptions in Kuwait, combined with prolonged SAP use observed in Chapter 2, section 2.3.4, underscores systemic issues in antimicrobial stewardship. In addition, misconceptions about prolonged SAP duration post-surgery align with global practice, potentially leading to unnecessary antibiotic

exposure and increased AMR (Abdel Jalil *et al.*, 2018; Ierano *et al.*, 2019a; Alahmadi *et al.*, 2020).

Finally, although 55.3% acknowledged that SAP prescribing contributes to AMR, this recognition was lower than that observed in the Nigerian study (90.2%) (Abubakar *et al.*, 2020). This gap suggests that many prescribers in Kuwait underestimate the long-term risks of inappropriate SAP use, which may stem from limited AMS training and the absence of national SAP guidelines. These findings highlight the need for enhanced AMS-related education within Kuwait's OB/GYN workforce.

3.4.3.3. Attitude section

Although most respondents (73.8%) agreed that SAP guidelines should be followed, the overall neutral attitude observed suggests that clinicians support guideline adherence in principle but lack the confidence or clarity to apply these recommendations consistently in practice. This neutrality likely reflects the substantial knowledge gaps identified in the knowledge section, especially regarding timing and antibiotic selection, which can undermine prescribers' ability to implement guidelines effectively. Additional factors, such as variability in local protocols, limited access to updated international guidelines, and hierarchical influences within clinical teams, may further contribute to uncertainty. Previous studies have shown that clear, well-disseminated guidelines combined with structured education and training programs significantly improve attitudes and adherence to SAP protocols (Ng *et al.*,

2012; Segala *et al.*, 2020; Hassan *et al.*, 2021). Therefore, interventions in Kuwait should focus on improving guideline clarity, providing targeted training, and implementing audit-feedback mechanisms to strengthen clinicians' confidence and translate positive intentions into consistent, evidence-based practice.

Clinicians held differing views on the appropriateness of broad-spectrum antibiotic use for SAP, highlighting an important attitudinal barrier to optimal prescribing. Nearly half (44.6%) mistakenly perceived broad-spectrum antibiotics as superior for SSI prevention. This belief mirrors global misconceptions that broader coverage equates to better protection, despite evidence showing that indiscriminate use increases AMR and risks to both mothers and neonates (Gagliardi *et al.*, 2009; Branch-Elliman *et al.*, 2019). Contributing factors to such an attitude likely include limited awareness of the implications of AMR and poor dissemination of updated guidelines. This attitude is consistent with the PPS findings in Chapter 2, Section 2.3.3, where ceftriaxone (a broad-spectrum antibiotic) was frequently used for prophylaxis. Such attitudes reinforce inappropriate prescribing patterns and highlight the need for targeted AMS and SAP stewardship training.

Conflicting attitudes were also observed regarding adherence to aseptic techniques in the operating room, indicating potential institutional-level influences on prescribing behaviour. More than half of the participants expressed uncertainty or disagreement about consistent adherence to aseptic

protocols. Poor adherence to aseptic technique is associated with higher SSI rates (Pinchera *et al.*, 2022), and this is also associated with increased use of antibiotic prophylaxis to mitigate the poor aseptic techniques (Upadhyaya *et al.*, 2023). This pattern highlights a systemic issue in which reliance on antibiotics substitutes for proper aseptic technique and infection control measures, potentially undermining AMS efforts. Such attitudes may stem from variability in the enforcement of aseptic standards, resource constraints, and hierarchical influences within surgical teams. Strengthening institutional adherence to aseptic standards through audits and feedback and staff training may indirectly improve the appropriateness of SAP (Hassan *et al.*, 2021; Mwita *et al.*, 2021).

Participants also demonstrated variable beliefs regarding factors influencing SAP duration, including the misconception that patient hygiene should dictate prophylaxis length. Approximately one-third (33%) agreed with this incorrect statement, reflecting a broader uncertainty about the determinants of SAP duration. This attitude contradicts guideline recommendations, which base SAP duration on procedure risk and intraoperative conditions, not patient hygiene (Birgand *et al.*, 2023). This attitude could contribute to prolonged postoperative antibiotic use, as observed in the PPS findings in Chapter 2, Section 2.3.4.3, and highlight areas where attitudes may unintentionally support practices that increase AMR risk. Such misconceptions may stem from poor dissemination of updated guidelines, reliance on local norms, and the absence of national SAP protocols. Comparable findings in Sudan and Nigeria

underscore that this issue is not unique to Kuwait but reflects a broader challenge in translating guidelines into practice (Ahmed *et al.*, 2019).

3.4.3.4. Practice section

The practice section explored clinicians' SAP-related responsibilities, adherence to guidelines, prescribing habits, and the factors influencing their decisions. Overall, participants demonstrated an adequate level of practice according to the predefined scoring categories. However, notable variability in adherence to recommended guidelines indicates gaps between intended and actual practice.

Most participants (63.7%), particularly OB/GYN clinicians, reported taking responsibility for prescribing SAP, and half (50.5%) ensured its administration before surgery. Despite this, only 42.9% consistently prescribed a single pre-operative dose, as recommended by ACOG (2018), while the remainder showed variable adherence. This is likely due to differences in institutional policies and protocols across hospitals in Kuwait and between private and public sectors, as previously documented in Kuwait (Alsabah *et al.*, 2021; Hassouneh *et al.*, 2023). These organisational and system factors likely contribute to inconsistent prescribing practices (Kasse *et al.*, 2024). The frequent practice of combining anaerobic antibiotics with cephalosporins, reported always by 23.1% and sometimes by 38.5% of participants, further deviates from guideline recommendations. This highlights the lack of standardisation in SAP practice in Kuwait and a potential gap between clinical

practice and guideline recommendations, suggesting issues related to knowledge of guidelines, accessibility, or adherence in actual practice.

Documentation practices were comparatively strong, with nearly half (48.4%) always documenting SAP orders and 50.5% recording stop dates. Nonetheless, post-operative antibiotic use remained high; 34.1% prescribed them sometimes, 18.7% most of the time, and 24.2% always. This practice contradicts the ACOG (2018) and other international guidelines, which recommend discontinuing SAP after surgery to prevent unnecessary antibiotic exposure, reduce antibiotic-associated side effects and prevent AMR development (Branch-Elliman *et al.*, 2019; Hawn *et al.*, 2019). Similar trends have been reported globally, with post-operative use ranging between 16.4% and 43.8% (Tanvisut *et al.*, 2023; Doğan *et al.*, 2024a). The persistence of prolonged prophylaxis, including in several LMICs (Abubakar *et al.*, 2018; Ahmed *et al.*, 2019; Saleem *et al.*, 2023), possibly due to the high infection rate, limited resources or poor hygiene in operating theatres (Salahuddin *et al.*, 2022; Girdhar *et al.*, 2024). However, in the Kuwaiti context, several interrelated mechanisms likely contribute to this deviation. First, defensive prescribing practices might be adopted by clinicians to avoid medical and legal consequences, particularly for obstetrics procedures such as C-section, which has a significant risk to the mother and baby. Therefore, clinicians might overprescribe antibiotics even after the end of the surgery “just-in-case”. Second, the influence of senior clinicians might be a major factor influencing the prescribing behaviour despite the evolving evidence. Third, the uncertainty

of aseptic technique in the operating theatre might reduce confidence in relying solely on preoperative doses, leading to extended prophylaxis as a precautionary measure. Furthermore, the gaps in knowledge about SAP duration could continue to reinforce outdated practices. Finally, the absence of national guidelines in Kuwait and the lack of standardisation reinforced the institutional variation, leading to inconsistent prescribing habits.

Several influential factors shaped clinicians' prescribing behaviours. Antibiotic availability (62.6%) and senior influence (56.0%) were the most frequently reported drivers of deviation from guidelines. The limited influence of cost (56% reporting no impact) reflects Kuwait's high-income healthcare system, where medication costs are not typically a barrier. Hierarchical pressures mirror findings from other settings, where junior clinicians' prescribing decisions are shaped by senior colleagues even when these contradict evidence-based recommendations (Nicolaou-Ghekas *et al.*, 2023). Limited experience and clinical complexity may contribute to junior clinicians' reliance on senior advice (Waller *et al.*, 2022).

A notable finding among respondents was the limited engagement with pharmacists and microbiologists, with 80.2% and 72.5% of participants, respectively, reporting that they "rarely" consult these professionals. Instead, clinicians relied predominantly on books or articles (81%). This contrasts with international evidence showing that pharmacists are often key resources for ensuring SAP appropriateness (Hassan *et al.*, 2021; Wu *et al.*, 2021;

Jantarathaneewat *et al.*, 2022). Although pharmacists are drug experts, they often face challenges, such as limited advisory roles, communication barriers and lack of empowerment, which may hinder their ability to influence prescribing decisions (Wong *et al.*, 2021). These findings suggest insufficient interdisciplinary collaboration in SAP decision-making, despite strong evidence supporting pharmacist-led improvements in antibiotic stewardship (Gautam *et al.*, 2015).

Collectively, these findings reflect weak interdisciplinary collaboration and highlight how structural, organisational and behavioural factors can reinforce poor prescribing practices. When knowledge is low, attitudes are neutral or inconsistent, and pharmacists or microbiologists are not routinely involved in decision-making, prescribers can be more vulnerable to relying on routine prescribing or habitual prescribing influenced by seniors or non-evidence-based practice. These findings highlight the need for including drug and microbiology experts through AMS interventions and audit and feedback mechanisms to optimise the prescribing practice of SAP in OB/GYN surgery.

3.4.3.5. Best strategies to optimise SAP prescribing in Kuwait:

When participants were asked to identify the best strategy to optimise SAP prescribing, the top choice was the development of a national guideline with 399 points. This stresses the need for a standardised approach to SAP prescribing across Kuwait to reduce inconsistency in SAP practice. As shown throughout the KAP and PPS (Chapter 2) findings, practice varies widely

between hospitals, sectors, and specialities, partly due to the absence of a single national guideline. A unified guideline may reduce uncertainty among clinicians, standardise practice across sectors, facilitate the audit and feedback process, and act as a foundation for standardised education for all levels of clinicians (Sartelli *et al.*, 2024). Systematic reviews showed that Countries that have developed and implemented national SAP guidelines report significantly improved adherence and reduced postoperative antibiotic misuse (Dhole *et al.*, 2023; Sefah *et al.*, 2024).

The second most important strategy was staff education and training, with 327 points, highlighting the value of these interventions as a starting point for improving SAP prescribing practices. Given the low overall knowledge score among participants, education and training can be a foundational AMS behavioural intervention, as they can help address misconceptions among clinicians, understand the guidelines, and improve guideline compliance. Regular, structured training can also help standardise practice, especially given the varied medical training backgrounds (Langdridge *et al.*, 2024).

Audit and feedback from clinical pharmacists was ranked third with 239 points, emphasising the pharmacist's role in enhancing prescribing practice through targeted feedback and promoting guideline compliance. This aligns with international AMS evidence showing that pharmacist-led audit and feedback is one of the most effective strategies for improving guideline adherence and reducing unnecessary antibiotic use (Ababneh *et al.*, 2021; Pereira *et al.*,

2022; Sefah *et al.*, 2025). However, the practice section results showed limited interaction with pharmacists in Kuwait, suggesting that, while clinicians recognise the value of pharmacists, some challenges, such as structural or institutional factors, may prevent this involvement or engagement. Strengthening multidisciplinary communication and formally integrating pharmacists into SAP decision-making may therefore enhance the impact of this strategy (Fesus *et al.*, 2021).

Although antimicrobial stewardship programmes were recognised as essential, they were viewed as less critical with 231 points, possibly due to the perceived challenges and resource demands associated with them (Abbas, 2024; Shah *et al.*, 2024). Nonetheless, the AMS program emphasises core components such as guidelines implementation, education, audit, and feedback, the same strategies that clinicians ranked most highly. This suggests that clinicians may value AMS activities but prefer interventions that are immediately actionable and require less structural change.

Research was ranked as the least important strategy for optimising SAP prescribing with 229 points. This may reflect a lack of a research culture in Kuwait or a preference among participants for strategies with immediate impact, such as training, education, and guideline development, over long-term solutions like research. However, research is essential for evaluating intervention effectiveness, monitoring compliance, understanding local resistance trends, and ensuring continuous improvement in SAP practice.

Without ongoing research, gains achieved through guidelines and training may not be sustained (Shah *et al.*, 2024).

Overall, clinicians' rankings align with AMS interventions and principles, emphasising the need for a national guideline, regular education, and pharmacist-led audit and feedback as foundational interventions for improving SAP practice in Kuwait.

3.4.4. Strengths and limitations

3.4.4.1. Strengths

This study is the first in Kuwait to assess the knowledge, attitudes, and practice of OB/GYN and anaesthetists towards SAP prescribing in OB/GYN surgery, providing a novel insight into behavioural and prescribing patterns within this speciality. A major strength is that this study builds on the findings of the previous study in Chapter 2 and triangulates the findings, thereby enhancing the robustness of interpretation by linking self-reported practice with observed prescribing behaviour. The data collection tool was validated by experts and piloted to ensure its validity and reliability. The survey also demonstrated acceptable internal consistency when Cronbach's alpha was calculated. The survey included all clinicians who are associated and responsible for SAP prescribing across both the public and private sectors, representing the national context. Also, the study outcomes can identify targets for potential AMS interventions and strategies to optimise SAP prescribing practice in Kuwait

3.4.4.2. Limitations

However, several limitations should be acknowledged. A key limitation was a low response rate (8.9%), which limits the generalisability of results and may introduce non-response bias. Low participation has also been observed in other Kuwait-based surveys, such as a population survey reporting high non-contact and refusal rates (Tariq *et al.*, 2013). This suggests that achieving high participation in questionnaire-based studies may be challenging within the Kuwaiti context. Difficulties in recruiting clinicians from the private sector may have further contributed to the low response rate. The small sample size also increases the risk of type II errors, which could be avoided with a larger sample size.

Furthermore, self-reported data may introduce response and desirability biases, leading clinicians to overestimate good practice or a positive attitude to align with perceived expectations (Grimm, 2010). This could be more relevant in KAP studies, particularly when it is about prescribing behaviour, where respondents may be hesitant to report incorrect answers or deviations from guidelines. However, this was mitigated by anonymising the survey and conducting the PPS study in Chapter 2, which showed overall poor prescribing practice.

A further methodological limitation relates to the formal assessment of content validity. Although the questionnaire underwent expert review by two independent academic reviewers with expertise in survey design and SAP

research, and was subsequently piloted with five OB/GYN clinicians, the Item Content Validity Index (I-CVI) was not formally calculated. The I-CVI is a quantitative measure of content validity that requires at least three independent expert raters to assign numerical relevance ratings to each item, enabling a standardised assessment of whether items adequately represent the construct of interest (Polit *et al.*, 2006). In this study, expert review was conducted as a qualitative feedback process focused on clarity flow and face validity, rather than as structured numerical rating exercise, and the number of reviews was below the minimum recommended for meaningful I-CVI calculation. Therefore, the formal demonstration of item-level content validity was limited. Future studies of this tool should include a structured I-CVI exercise with a minimum of three to five content expert to strengthen the evidence-based for its validity and support its use in other regional settings.

In terms of data collection, redesigning the survey tool to include negative-worded questions can help mitigate acquiescence and response bias. In the knowledge section, the first two multi-answer questions required selecting all correct options. A proportion of participants (38.9%) selected all options, potentially inflating incorrect responses. To enhance the assessment's validity, half a mark was deducted for each incorrect answer. This method was consistently applied to all other participants to ensure a more accurate overall score and minimise response bias. However, it could potentially lower the overall knowledge score. Therefore, excluding multiple-answer questions in future KAP survey designs may simplify the scoring process for the knowledge

section. Despite these limitations, this study provides valuable baseline evidence on SAP-related KAP among OB/GYN prescribers in Kuwait and highlights key behavioural and system-level targets for future AMS interventions.

3.4.5. Clinical implication

The findings highlight several issues, including a lack of knowledge, variability in guideline awareness and practice, and adherence, as well as possibly inconsistent SAP training across different educational backgrounds. The lack of uniformity in recognising SAP protocols for specific surgical categories underscores the need for more focused, accessible training programs and clear, straightforward guidelines that can be easily applied in clinical practice.

This study highlighted the need for actions, including improved training and targeted educational initiatives, to enhance knowledge of SAP across a wider range of OB/GYN procedures and appropriate SAP prescribing. Additionally, there is a need for national guidelines with regular updates and clear, accessible dissemination regarding SAP prescribing in OB/GYN surgery to standardise practice. Lastly, ongoing medical education and reminders about the importance of SAP in preventing postoperative infections should be tailored to include all relevant OB/GYN procedures.

3.4.6. Recommendations

Further research is necessary to identify the factors that hinder and promote appropriate prescribing and adherence to SAP guidelines. In addition, there is a need for further research to identify the factors that influence the adoption and preferences of these guidelines among prescribers. It is recommended that a national Kuwaiti SAP guideline be developed, that the accessibility of this guideline is improved, and that there is regular, updated clinical training to enhance adherence to best practice.

In addition, further studies are needed to evaluate the implementation of targeted educational programmes that clarify SAP guidelines and emphasise the rationale behind antibiotic use for different types of surgeries, specifically targeted at OB/GYN surgeons. By addressing these recommendations and acknowledging the limitations, this study offers an overall understanding of the current KAP among clinicians and provides a foundation for future improvements.

3.4.7. Conclusion

The study revealed significant gaps in clinicians' knowledge, attitude and practice. Overall knowledge was low, with common uncertainty regarding wound classification, antibiotic selection, timing, duration and procedure-specific recommendations. Although attitudes towards guideline adherence were generally neutral, misconceptions were evident, particularly regarding the perceived superiority of broad-spectrum antibiotics and the influence of non-clinical factors such as patient hygiene on SAP decisions. Self-reported SAP

practice was largely adequate, yet this contrasted with the PPS findings in Chapter 2, which showed high rates of inappropriate antibiotic selection, timing, and prolonged postoperative use.

The observed variation in knowledge and practice across specialities, levels of experience, and training backgrounds highlights the lack of standardised guidance and inconsistent exposure to SAP protocols within the Kuwaiti healthcare system. These gaps highlight the urgent need to develop national Kuwait guidelines, supported by regular training, audit and feedback, and targeted AMS interventions. This is necessary to standardise prescribing practice, enhance the effectiveness of SAP, and reduce the risk of surgical site infections in OB/GYN surgery.

Chapter 4. Exploring the Perceptions of Obstetricians and Gynaecologists in Kuwait Regarding Appropriate Surgical Antibiotic Prophylaxis: Barriers, Facilitators, and Public Health Implications

4.1. Introduction:

Assessment of surgical antibiotic prophylaxis (SAP) prescribing practice, along with doctor's knowledge, attitudes, and practice toward SAP, have been investigated in the previous chapters (Chapters 2 and 3). This revealed suboptimal SAP prescribing practice in Kuwait, underpinned by gaps in clinicians' knowledge and attitudes towards appropriate SAP use, consistent with global literature reporting similar behavioural and educational issues (Gouvea *et al.*, 2015; Abdel Jalil *et al.*, 2018; Khan *et al.*, 2020c). Issues such as inappropriate SAP timing, prolonged duration, and the overuse of broad-spectrum antibiotics were observed; however, the reasons underpinning these observations still remain unknown. Therefore, understanding the behavioural and systemic barriers and facilitators that influence and explain the observed SAP prescribing is essential. The data gathered from Chapters 2 and 3 provided quantitative insight into the level of inappropriate practice, but it cannot explain the reasons behind this practice and these behaviours. This gap needs to be addressed through in-depth qualitative research to explore the facilitators and barriers to the observed poor/sub-optimal and inappropriate SAP prescribing in OB/GYN surgery in Kuwait from the clinician's perspective.

Previous studies have identified a range of barriers and facilitators to appropriate SAP prescribing. For example, a systematic review examining

studies published between 1998 and 2018, which aimed to identify barriers and enablers to adherence to SAP guidelines, highlighted factors such as inadequate knowledge and skills, unclear professional roles, poor communication, and constrained environmental resources as key barriers to compliance (Hassan *et al.*, 2021). Other research has reported issues such as weak feedback mechanisms, hierarchical decision-making, and limited multidisciplinary collaboration, while facilitators included education, audit and feedback and the presence of clear institutional guidelines (Wu *et al.*, 2022; Harun *et al.*, 2024).

Most of this evidence has been gathered from healthcare systems that differ significantly from Kuwait in terms of organisational structures, professional hierarchies, and cultural norms. In contrast, the Kuwaiti healthcare system is characterised by a highly international medical workforce, comprising doctors, nurses, and allied health professionals from diverse countries and training backgrounds. This diversity, along with variations in the implementation of local guidelines and the ongoing development of antimicrobial stewardship infrastructure, contributes to variability in prescribing practices and adherence to SAP recommendations. Consequently, it is essential to analyse the behavioural, cultural, and systemic factors affecting SAP prescribing in Kuwait's healthcare environment.

The COM-B (capability, opportunity, motivation, and behaviour) is a comprehensive framework for understanding the determinants of human

behaviour within specific contexts (Atkins *et al.*, 2017). It suggests that behaviour results from an interaction between an individual's capability (knowledge and skills), opportunity (external factors that enable or hinder the behaviour), and motivation (internal processes that direct or suppress action). This framework can be applied to explore a wide range of health-related behaviours, including antimicrobial prescribing. In this study, the COM-B model was utilised to describe the behavioural factors influencing SAP prescribing decisions in Kuwait.

This chapter builds on the findings of the previous chapters by exploring the underlying cultural and contextual factors that explain the suboptimal SAP practice identified earlier. The insights derived from the COM-B analysis are crucial for identifying and recommending targeted strategies to mitigate inappropriate SAP prescribing in Kuwait through tailored antimicrobial stewardship interventions, which ultimately contribute to the reduction of antimicrobial resistance (AMR).

4.1.1. Aim

To identify and explore barriers and facilitators to appropriate SAP prescribing and guideline compliance in Kuwait, using the COM-B model as a theoretical framework to inform behaviour change interventions.

4.1.2. Objectives

- To explore clinicians' experiences and perceptions of SAP prescribing practice in Kuwait
- To identify and explore barriers and facilitators to appropriate SAP prescribing using the COM-B model as a guiding analytical framework
- To conduct and analyse semi-structured interviews using thematic analysis structured around the COM-B model components
- To map identified barriers and facilitators onto the Behaviour Change Wheel (BCW) to identify feasible antimicrobial stewardship intervention functions
- To make evidence-based recommendations for improving SAP prescribing practice in Kuwait

4.2. Methods

4.2.1. Study design and participants

This study employed a qualitative exploratory design to understand SAP prescribing in Kuwait. The study used detailed, semi-structured interviews guided by the COM-B model and informed by findings from Chapters 2 and 3, to explore key factors influencing appropriate SAP prescribing, focusing on both barriers and facilitators. Participants were OB/GYN doctors working in either the public or private sectors in Kuwait.

4.2.2. Topic guide development and piloting

The interview topic guide (Appendix 4.1) was developed through a structured iterative process drawing on three complementary sources: published literature (Ierano *et al.*, 2019b; Hassan *et al.*, 2021), the COM-B model and the sequential findings from chapters 2 and 3. The topic guide consisted of open-ended and semi-structured questions. From the published literature, two key sources shaped the guide's thematic scope. Firstly, Hassan *et al.* (2021) conducted a systematic review of barriers and facilitators to SAP guideline adherence published between 1998 and 2018 which identified inadequate knowledge and skills, personal beliefs, limited access to guidelines, organisational constraints, and a hierarchical prescribing culture as the principal determinants of inappropriate SAP prescribing. These domains directly informed the development of questions under the COM-B Capability and Opportunity components. Secondly, Ierano *et al.* (2019b) conducted a qualitative study examining factors influencing SAP prescribing in Australia, highlighted poor communication and documentation practices, unclear role responsibility between surgeons and anaesthetists, and the absence of feedback mechanisms as key institutional barriers, findings that shaped questions on documentation, multidisciplinary working, and audit under the Opportunity and Motivation components. From Chapter 2, several findings identified in Kuwait required direct exploration of the underlying reasons including: the universal use of postoperative antibiotics beyond 24 hours, the predominance of broad-spectrum watch list agents, poor preoperative documentation of SAP and absence of local guidelines. These patterns

generated specific topic guide questions exploring prolonged prescribing, antibiotic selection, guideline accessibility, and documentation practices. From Chapter 3 (the KAP survey), findings showed that knowledge of specific SAP parameters (timing, duration, first-line agent) was low, suggesting a gap between their understanding of established guidelines and their understanding of the content, which raised questions about the source and quality of SAP training. The COM-B model was chosen as the framework for developing the topic guide because of its comprehensive approach to understanding behaviour. It suggests that behaviour is driven by three key factors: capability, which includes physical abilities and psychological knowledge; opportunity, referring to physical resources and social influences like norms; and motivation, encompassing both reflective aspects such as beliefs and automatic processes like habits (Atkins *et al.*, 2017). The COM-B model has been widely used to explore barriers and facilitators in healthcare settings and supports changes in healthcare practice (Turner *et al.*, 2023). Its flexibility and relevance to clinical contexts made it an ideal choice for this study.

The topic guide began with an exploration of participant's understanding and knowledge of SAP. Participants were then asked to describe their own SAP prescribing practice, focusing on aspects such as the timing, selection and duration of antibiotics. The questions progressed to explore factors influencing their prescribing decisions, including whether they followed local or international guidelines and how these guidelines were adapted to fit their clinical practice. The researcher also presented a brief verbal summary of the

findings from the first and second studies (Chapters 2 and 3), and participants were asked to share their opinions regarding these findings. The interview concluded with questions about perceived barriers and facilitators to appropriate SAP prescribing, and potential strategies to optimise SAP prescribing in Kuwait.

The topic guide was reviewed by the project supervisors (AK and AB) and an independent academic researcher (ED). It was piloted with one specialist OB/GYN and one junior OB/GYN doctor. The pilot interviews lasted less than an hour. No concerns or issues were raised, and therefore, no modifications were made to the topic guide following piloting.

4.2.3. Study recruitment strategies

Participants for this study were recruited using a combination of convenience and snowball sampling (Palinkas *et al.*, 2015). Initially, one gynaecologist in Kuwait assisted in identifying and contacting potential participants who met the inclusion criteria. Eligible participants were practising obstetricians or gynaecologists involved in prescribing, administering, or overseeing SAP in OB/GYN surgery within public or private hospitals in Kuwait. During the interviews, participants were asked to recommend other doctors who would be interested in participating in the study. This snowball sampling method expanded the participant pool by using the professional connections of the initial interviewees. Also, all heads of OB/GYN departments in the public sector were approached by the researcher to suggest potential participants. A target

sample size of ten participants was planned, followed by three additional interviews to confirm data saturation (Francis *et al.*, 2010). Recruitment of participants continued until data saturation was achieved, defined as the point at which no new themes emerged during analysis (Francis *et al.*, 2010).

4.2.4. Conducting the interviews

4.2.4.1. Interview invitation process

An invitation letter (Appendix 4.2) and a Qualtrics® link (Appendix 4.3) were developed. The Qualtrics® link directed participants to the information sheet (PIS), consent form, contact details, and demographic questions. Initial recruitment was supported by a gynaecologist, who disseminated the invitation letter and Qualtrics® link with her colleagues through WhatsApp®. To reach a broader group of participants, the same materials were also distributed to the heads of OB/GYN departments in public hospitals, who circulated them among eligible clinicians. Participants who consented and provided their contact details through Qualtrics® were subsequently contacted by the researcher to arrange a convenient time and format for the interview. Participants were offered the choice of an online interview via Microsoft Teams® or an in-person meeting at their office or a designated meeting room at their workplace. The interviews were conducted between 25 December 2023 and 25 January 2024.

4.2.4.2. Interviews – Data collection

At the start of the interview, the primary researcher made sure that the participant had provided consent on Qualtrics®. Participants were reassured that the interview would be anonymous and that all information would be kept

confidential. They were also informed that participating in this study was voluntary and that they could withdraw at any time. All interviews were conducted in English.

4.2.5. Data organisation and management

All interviews, whether in person or online, were audio-recorded. After each interview, the audio file was transferred to a secure password-protected university OneDrive® account and subsequently deleted from the recording device to ensure data security and confidentiality. The audio files were transcribed verbatim using the transcription feature in Microsoft Word®. To confirm accuracy, the researcher listened to each recording while reviewing the transcript, correcting any errors or omissions as necessary. During transcription, all personal and identifiable information was removed to ensure anonymity. Each transcript was assigned a unique participant ID, known only to the researcher, ensuring anonymity throughout the analysis process. The transcripts and their corresponding audio files were verified by an independent researcher to confirm the accuracy and reliability of the transcription. All transcripts were uploaded and securely stored in PURE, the research management system at the University of Strathclyde, in accordance with the University's data retention policy. Transcripts will be kept securely for a minimum of 10 years.

4.2.6. Data analysis process

The data were analysed using thematic analysis, guided by Braun and Clarke's (2006) six-phase framework. The first phase, familiarisation with the data, involved the researcher immersing himself in the data by reading and re-reading the transcripts and listening to the recordings. The second phase, generating initial codes, was carried out using NVivo® software to systematically analyse and organise the data. Coding was done both inductively, allowing themes to emerge naturally from the data, and deductively, informed by the COM-B model to ensure alignment with the study's objectives. These codes were further grouped manually and organised under the relevant COM-B components (theme) and subdomains (subthemes) such as physical and psychological capability, physical and social opportunity, and reflective and automatic motivation. This systematic approach enabled an in-depth exploration of facilitators and barriers influencing SAP prescribing in Kuwait. The third phase involved searching for themes by reviewing initial codes: similar codes were merged to reduce redundancy. Related codes were grouped into potential themes and sub-themes and then mapped onto the COM-B model. The fourth phase, reviewing themes, involved assessing the coherence of the themes. The fifth phase, defining and naming themes, the final themes and sub-themes were clearly defined and named to summarise their essence. The sixth and final step, producing the report, involved integrating the themes into a coherent narrative that aligned with the study objectives. Representative quotes from participants were selected to illustrate the findings.

The analysis process was documented to maintain consistency and credibility. Two independent researchers validated the coding process to enhance the rigor of the analysis. First, an independent researcher (AF, an academic researcher with expertise in qualitative research) independently coded three transcripts selected at random, representing approximately 23% of the total sample (3/13). Second, an independent researcher from outside the field (DE, a PhD student in psychology with expertise in qualitative research) independently coded approximately three transcripts from a different randomly selected subset, representing a further 23% of the total sample. Together, independent coding validation was conducted on approximately 46% of all transcripts (6/13). Both researchers received the transcripts without access to the primary investigator's prior coding to ensure the independence of the process. Following independent coding, each set of codes was compared and discussed with the primary investigator in a structured review meeting. Any coding differences were discussed and resolved by consensus, thereby enhancing the reliability of the results.

4.2.6.1. Mapping barriers and facilitators to the Behaviour Change Wheel intervention functions

Following the thematic analysis, barriers and facilitators were systematically mapped to the Behaviour Change Wheel (BCW) framework to inform potential behaviour change strategies (Michie *et al.*, 2011). The BCW provides a structured method for designing behaviour change interventions by mapping key determinants of behaviour to nine broad intervention functions, including

education, persuasion, incentivisation, coercion, training, restriction, environmental restructuring, modelling, and enablement. Each COM-B subdomain was mapped to intervention functions as recommended in the BCW framework, based on the nature of the barrier or facilitator (e.g. knowledge gaps under psychological capability were linked to education and training functions).

4.2.7. Reporting standards

This study was reported in accordance with the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist (Appendix 4.4) to enhance transparency and completeness in reporting qualitative research findings (Tong *et al.*, 2007).

4.2.8. Ethical approval

Ethical approval was obtained from the Ethics Committee of the Ministry of Health in Kuwait (Appendix 4.4) on 29th October 2022. This approval was then endorsed by the Ethics Committee of the Strathclyde Institute of Pharmacy and Biomedical Sciences (SIPBS) (Appendix 4.5).

4.3. Results

4.3.1. Demographics

A total of 13 doctors specialising in OB/GYN were interviewed. The sample represented a mix of experience: four registrars (30.0%), three senior registrars (23.1%), three consultants (23.1%), and three assistant registrars (23.1%). The mean length of work experience was 14.7 years (SD $\pm$ 8.3) with

a mean age of 39.1 years (SD $\pm$ 8.3). The majority of doctors 11/13 (84.6%) worked in the public sector, and more than half 7/13 (53.8%) completed their medical training in Egypt.

4.3.2. Thematic analysis findings

Sixteen codes were identified through thematic analysis and mapped to the COM-B framework's three components: capability, opportunity, and motivation, including both barriers and facilitators to appropriate SAP prescribing (Table 4.1).

Table 4:1: Subthemes and codes mapped to the COM-B framework

COM-B core component (themes)	Subdomains	Subthemes
Capability	Physical capability	SAP documentation
		Experience of SAP prescribing
		Increasing training and awareness
	Psychological capability	Knowledge
Opportunity	Physical opportunity	Clinical decision-making process
		Drug cost and availability
	Social opportunity	Guidelines and policies
		Patient influences
		Audit and feedback
		Senior and peer influence on SAP prescribing
		Traditional practice
Motivation	Reflective motivation	Multidisciplinary team
		Beliefs about antibiotic efficacy and infection prevention
		Change in prescribing behaviour
		Preventative approach prescribing
	Automatic motivation	Punishments and incentive

4.3.3. Theme 1: Capability

The COM-B framework's "capability" component included five subthemes, categorised into two subdomains (physical and psychological capabilities). These subthemes explored factors such as training and documentation practice, the decision-making process, as well as knowledge.

4.3.3.1. Subdomain: Physical Capability

4.3.3.1.1. SAP documentation (Barrier)

A major barrier to appropriate SAP prescribing was inconsistent or absent documentation of SAP orders preoperatively and of the justification for SAP prolongation postoperatively. Participants explained that when SAP was not documented clearly or in advance, it created uncertainty about what had been prescribed or administered. The SAP orders documentation practice pre- and postoperatively varied among participants. Most participants reported that SAP was usually documented after surgery, whereas only a few recorded it earlier at the clinic or on admission, especially for elective surgery, leading to miscommunication between surgical, anaesthetic, nursing and pharmacy teams. Documenting SAP postoperatively without justifying the need can also lead to miscommunication and verification of the need for an extra course, increasing the risk of unjustified SAP prolongation. This practice was common among practitioners, as SAP was frequently seen as a routine or automatic task rather than an important clinical decision. This led many doctors to assume that SAP documentation is not required, leading to the omission of documenting the orders before surgery, especially when the same antibiotics were prescribed for most procedures.

Regarding elective surgery orders, one participant described the typical timing of documentation for elective procedures:

“While writing the admission in the OPD, it is usually two days before the operation we write for her admission.”

(P9, senior registrar)

Regarding preoperative SAP documentation routine among clinicians:

“When I joined OB/GYN, I didn't see people write it. But then when I go to surgery, it's very important like when you put the patients, you have to write the pre-orders, and one of them is antibiotic. But we don't usually think it's again because it's common practice, like people are not used to writing it, and the nurse will do it anyway. So they depend on the nurses, and therefore, they're not requested to write it for them.”

(P11, registrar)

Some participants relied on verbal instructions to nurses to administer SAP as standing orders before surgery, which further reduced the perceived need for documentation. However, in some cases, no written or verbal orders were provided, leading to uncertainty and reliance on nurses to inquire whether the patient required an antibiotic dose before the surgery or not.

One senior registrar described their approach:

“I was one of the team members who gave a standing order to the nursing staff that all patients going at least for a caesarean should receive the prophylactic antibiotics according to the policy.”

(P8, Senior Registrar)

The same participant further explained why they relied on verbal orders instead of documented orders.

“The aim of this [verbal orders], that doctors were not still used to writing clearly in the notes because due to practice in Kuwait, it is medical legally based on the doctor. So anything the doctor mentions should be followed, and anything he does not mention, no one should follow.”
(P8, senior registrar)

In contrast, another registrar highlighted a less structured practice:

“Sometimes it would be even like without it [verbal order], or the nurse would have to check because, as you're just asking, should I give this before or like a test dose prior? Then the doctor will have to confirm.”
(P11, Registrar)

The reliance on handwritten prescriptions was seen as a systematic barrier to appropriate SAP, due to the potential for forgetfulness and mistakes. One participant advocated for the implementation of an electronic prescribing system with automated reminders and alarms to avoid errors and allow follow-up by pharmacists or microbiologists.

“In our hospital, we have handwritten prescriptions, and so having like an electronic system with like, for example, alarms or reminders or something it might make it more simpler practice or easier practice. So therefore, there would be more communication like I don't like the microbiologist, or the pharmacist doesn't necessarily have to track me down and ask for my number, which is quite a bit of a hassle. It's just a simple reminder on the system, and then that makes practice more easy..... Because we go with that with handwritten and the paperwork everything. So, I think there is more room for error, more

room for like...ah...it's very difficult or very easy to not document everything or like miss something if it's too much workload, then you know things can go missing quite easy, so I think, yeah, that's that can be one of the barriers too."

(P11, Registrar)

In summary, inconsistent documentation was identified as a key barrier, often driven by a reliance on verbal communication, poor routine documentation practice, and the use of handwritten prescriptions. These practices reflect a limited physical capability to deliver appropriate SAP, which necessitates structural and procedural improvements, including the introduction of an electronic system and clearer accountabilities.

4.3.3.1.2. Reliance on experience over guidelines (Barrier)

Reliance on personal experience, especially that of senior doctors, was another key barrier to poor compliance with SAP guidelines. Participants highlighted that some senior doctors adhered to self-created SAP protocols based on their experience rather than the hospital's protocols. These protocols were often used routinely and remained largely unquestioned by their colleagues or other senior staff. A participant explained:

"The surgeon usually has the protocol by himself, you know. And for any surgery, E&C, simple or not simple, complicated or not complicated. It is his formula, so this is her/his experience with this.....They put this formula by themselves, and everyone maybe agrees about that, and I didn't find anyone who disagrees about the medications, you know."

(P5, Assistant registrar)

Some participants explained that learning through observation and imitation of senior clinicians' practice influenced their prescribing habits. This experiential learning promoted strong reliance on personal and shared experience, which often precedes evidence-based guidelines. Moreover, the influence of senior doctors reinforced the existing prescribing pattern, which resulted in greater scepticism and a lack of trust in new guidelines, compared to the accumulated experiential knowledge of their seniors. A participant explained:

"Sometimes, some people depend on what they have seen by their eyes. They don't trust the guidelines, for sure, do you understand? Like I've been prescribing this antibiotic for many years now, and I have never seen things with it. I have very few patients with recurring infections, very few cases of this, so I will write what I have seen with my eyes."

(P10, Consultant)

Another stated:

"It's like the personal opinion of the consultant or the seniors and their experiences in the like the 25 or 30 and 40 years of working.... maybe they said that experience is better than the protocol. It's not about only the antibiotics, it's about practice in general."

(P7, Assistant registrar)

When participants were asked about the practice of relying on personal experience over established guidelines, many expressed disagreement, emphasising that adherence to protocols and guidelines was generally preferable. However, some participants acknowledged that guideline

modifications might be necessary in specific cases, as senior doctors often have more experience and situational knowledge. One participant explained:

“Sometimes it's bad, but sometimes, yeah. I mean, they know better. I don't know. Sometimes some situations. Yeah, it's bad, but sometimes they know better.”

(P7, Assistant registrar)

Regarding the need to modify guidelines in certain situations, another participant shared:

“Guideline first, this is any as you see. This is my base when I go to see the patient. This guideline, and I think, is it applicable here for this patient or not? Then, I add my experience. You know, I have to modify this.”

(P3, Senior registrar)

In summary, participants indicated that there was widespread reliance on experience over established guidelines, particularly from senior surgeons. While some value their judgment, others expressed concern that these practices are inconsistent and undermine evidence-based prescribing, reflecting a significant gap in psychological capability.

4.3.3.1.3. Training and awareness (Barrier and facilitator)

Many participants reported a lack of training and education on the appropriate use of SAP as a significant barrier. In contrast, ongoing structured lectures and awareness activities on SAP guidelines and antibiotics were viewed as necessary facilitators to improve the prescribing of SAP. One participant noted:

“As I told you, because we really don't get much learning or focus on the type of antibiotics and when to prescribe.....I think there's no emphasis on learning. There are no lectures given.”

(P4, Assistant registrar)

They believed that training on guidelines, along with verbal reminders and handouts, could play a crucial role in improving prescribing practice. One participant shared how lectures and meetings were already being used to educate doctors on appropriate antibiotic use before surgery:

“Yeah, in the use of antibiotics before surgery and what type of antibiotic should be used, they give us lectures. Before surgery... In the meetings they do for us, meetings many times done for the new doctors and for the doctors practising to follow this protocol.”

(P9, Senior registrar)

Another participant emphasised the potential value of verbal reminders and printed materials in reinforcing appropriate practice:

“So, you know, having verbal reminders or even printouts or handouts and the doctor would help.”

(P11, Assistant registrar)

One participant noted that an ongoing structured scientific meeting for new staff was seen as a vital facilitator. Consistent reinforcement through these methods would help to bridge the knowledge gap among healthcare providers.

"We do here scientific meetings. Two scientific meetings per week to endorse the new doctors and newcomers. I also was a newcomer before and didn't know the protocol..... It's very important to provide information for the newcomer to avoid this mistake."

(P12, Registrar)

In addition to healthcare provider education, some participants emphasised the importance of educating patients to improve antibiotic prescribing practice. They argued that increasing patient awareness of the appropriate use of antibiotics could reduce overuse and foster informed discussions between patients and healthcare providers.

"To have more awareness, not for the people alone. I mean the general population. We have to have to have it also for the doctors, especially the surgeons."

(P8, Senior Registrar)

"We tell her [the patient] that if she has pain in the wound if she has a fever, if she has any signs of inflammation, to come to casualty, we tell her that prescribing an antibiotic is not mandatory."

(P1, Registrar)

Lastly, practising and training on using the guidelines is necessary to improve prescribing practice. However, this would take time to see an improvement in practice. One participant explained:

"Practice it, maybe. You know, the better is that we are getting, yeah, we haven't practised this before..... Perhaps because they have not practised it, it's not practised here. If it is practised, it will be ok. It will take time until it gets practised, it will be OK."

(P10, Consultant)

This subtheme emphasised that education and training are vital. While lack of training was seen as a barrier, structured scientific meetings, verbal reminders and lectures were seen as facilitators. Improving psychological capability through regular training and guideline implementation, and early induction for new staff, was seen as a critical strategy to optimise SAP prescribing in Kuwait.

4.3.3.1.4. Subdomain: Psychological capability

4.3.3.1.4.1 Knowledge gaps and misconceptions (Barrier)

Knowledge about antibiotic use and recent guidelines is a fundamental component of psychological capability in the COM-B framework, which could directly influence prescribing practice. Analysis revealed that the level of knowledge varied among participants.

Knowledge about SAP indication

Fortunately, all participants understood the purpose of SAP, which is to prevent surgical site infection (SSI). However, deeper clinical knowledge about SAP indication, appropriate timing, duration, and selection of antibiotics was inconsistent.

As one participant explained:

“From the name, it is prophylaxis. You want to prevent post-surgical infection because you know how patients who have surgery will open all layers of the abdomen. We enter the abdominal cavity, so organisms

may enter the cavity and cause sepsis or infection. This is very bad for the hospital, for the doctor and the patient in the 1st state."

(P2, Registrar)

When participants were asked which surgical procedures they would prescribe SAP, many participants shared varying practice and uncertainty regarding the classification of surgical procedures and the specific indications for SAP. While some presumed that all OB/GYN surgery requires SAP, regardless of the risk classification, others believed that it is not required to prescribe SAP for clean surgery but only for invasive surgery.

"So, our procedures, most of the time, involve opening the reproductive system, the uterus like in caesarean or vaginal delivery, we are accessing the reproductive system. So, they're still clean but not fully sterile. We need to open the cavity. So, I say all of them."

(P8, Senior registrar)

Another consultant emphasised that SAP is indicated for most surgery in OB/GYN:

"Almost all surgeries we do, like caesarean sections, are the most common procedure we do. We also do it for gynaecological operations like hysterectomies, ok. We also do it for laparoscopies."

(P10, Consultant)

Other participants mentioned that the procedure duration was an indicator for prescribing SAP, although the threshold varied. One participant explained:

“Well, clean surgery. It is not basically to do with the clean surgeries. It's the time of exposure this is, I believe, it's more than 30 minutes or 45 minutes, we take a cut-off of 45 minutes. Any surgery which lasts more than 45 minutes, we prefer giving them an antibiotic or rather topping it up with another course of antibiotics. So, clean surgeries um...as...a practice here in Kuwait, I don't know about abroad. We give antibiotics for all the cases that we do in OB/GYN.”

(P1, Registrar)

When further asked to define prolonged surgery, participants reported various definitions. Some suggested that surgery lasting over 45 minutes could be considered prolonged, while others believed a procedure exceeding an hour and a half, particularly in the presence of complications such as adhesions or bleeding, would qualify as prolonged surgery. One participant described the typical duration of surgery and what constitutes a complicated case that requires SAP:

“The average C-section is a maximum of one hour to 1:30 hours, maximum two hours. For all procedures from the patient enters the OT [operating theatre], the operational room to get out is two hours or one and half hours, but incision time it will take it depends on the surgeon, but it averages from 30 to 45 minutes.”

(P12, Registrar)

The participant further elaborated on complicated surgical cases:

“A complicated case, maybe involve placenta previa or bleeding, or hysterectomy Or Caesarean hysterectomy or if there is any adhesion, or there is intestinal injury or colon injury or bladder injury, and we need another team to come urology, for stent and or surgery come to suturing anything. Yeah. I think we will give antibiotics.”

(P12, Registrar)

Understanding of SAP timing

Regarding the timing of SAP in relation to skin incisions, participants described varying practice. Some stated that antibiotics are administered immediately at incision due to uncertainty about the exact timing of surgery. Others mentioned giving the dose after a test dose in the ward or just before transferring the patient to the operating room within 30-60 minutes. One consultant explained their practice:

“Immediately because one hour, maybe, sensitivity test, I cannot guarantee when I start the surgery once the patient is on the bed and within 10 minutes. Before starting local spinal anaesthesia, he [anaesthetist] will give the antibiotic one shot.”

(P13, consultant)

In the case of emergency procedures, intra-operative SAP was a common practice due to the limited timing for patient preparation after the test dose (skin test).

“For emergency, it's for sure. We will give it during surgery. Because if it's an emergency, that means that for any patient who we are sending for theatre, there will be enough time. At least we can give a test dose. This is the maximum we can give before sending her.”

(P9, senior registrar)

The participants were shown data on inappropriate timing from a previous study (Chapter 2) (e.g., administration of SAP more than 60 minutes before or after surgery, and sometimes during surgery). All participants disagreed with

that practice, insisting that SAP should be administered before surgery (30 - 60 minutes) or immediately before the skin incision.

“This is a wrong practice, so as I told the Royal College recommendation, this one should be within one hour. It means this patient, as I told you, we're giving intraoperative [before skin incision].”
(P6, Consultant)

Broad-spectrum preference

Most participants favoured using broad-spectrum antibiotics over narrow-spectrum agents. Although they were aware of the potential risk of AMR, they still believed it was better to prescribe broad-spectrum antibiotics to cover a wider range of infections. This preference was largely driven by the uncertainty about the specific pathogens contaminating the surgical theatre and the perceived lack of sterility in the operating theatre. When asked why, some participants expressed concern that infection could arise from multiple sources, such as airborne contamination, surgical instruments, or endogenous flora, leading them to favour broad-spectrum coverage as a precautionary measure.

“Maybe you are increasing the resistance from the future, but it [broad-spectrum] covers better or more infections.”
(P7, Assistant registrar)

These justifications highlight an underlying belief that antibiotics can compensate for perceived weaknesses in infection prevention and control (IPC). Rather than addressing IPC concerns directly, some clinicians

responded by broadening antimicrobial coverage, indicating a reliance on antibiotics as a protective measure in situations where IPC systems were viewed as insufficient.

“Broad-spectrum is better to cover all organisms or suspected organisms. We have the air around the surgery, around the wound inside, maybe something indigenous. Gram-negative, maybe urinary tract infection, sepsis anywhere. So, it is better to cover all. Broad-spectrum is better..... You cannot guarantee all this antiseptic measures the surgeon under, and you're going to do the surgery. I cannot go for the staff nurse here and I check she's It's full scrapping before the surgery, maybe scrubbed in a hurry maybe have some common cold, some infection, some bacteria infection carrying MRSA, carrying any infection. I don't know exactly”

(P13, Senior registrar)

This preference contributed to the widespread use of combination prophylaxis of metronidazole with ceftriaxone or cefuroxime, even for clean or uncomplicated procedures. This combination was identified as the most prescribed postoperative regimen to prevent infection. Participants were specifically asked to explain their reasons for using these combinations. They explained that this combination provides broad-spectrum coverage, targeting anaerobic, gram-positive, and gram-negative organisms. Their explanations were based on their own clinical understanding, as no one referred to specific evidence or guideline recommendations when justifying this combination.

One participant described:

“This combination is OK. This combination [metronidazole plus cephalosporin post-operation] is right. We’ll make sure to cover gram-positive and gram-negative, and yes, this combination is OK.”
(P3, senior registrar)

Another stated:

“We involve a lot of genitourinary systems; we prefer giving broad-spectrum plus anaerobic infection antibiotics as well. So, it’s always a combination of broad-spectrum plus anaerobic. So, it will be Rocephin [ceftriaxone], or Zinacef [cefuroxime], or Flagyl [metronidazole] or Dalacin [clindamycin].”
(P1, registrar)

These responses suggest that their prescribing decision was primarily driven by a perceived need for comprehensive microbial coverage (aerobic and anaerobic), reflecting a defensive prescribing culture motivated by peer pressure, avoiding legal or clinical complications. These behaviours are explored further in subsequent sections (4.3.2.2.1, 4.3.2.2.2 and 4.3.2.3.2.3). However, some participants acknowledged that anaerobic infections post-surgery were uncommon unless there were specific complications, such as bowel injuries. One participant stated:

“It’s uncommon [anaerobic infection] unless they have, like, let’s say, a bowel injury.”
(P4, Assistant registrar)

Other participants accepted the practice but limited it to certain cases, like GYN surgery or emergency C-section or high-risk patients who are more vulnerable to infections, such as diabetic, obese or febrile, as one stated:

“Or to cover both aerobes and anaerobes. Like Flagyl [metronidazole], we prescribe mostly in GYN cases, not in obstetric cases. As you know, GYN more dynamic cases, mostly vaginal. And also, there are some of some tests we do. It may rupture during extraction. It's better to cover with metronidazole plus ceftriaxone.”

(P12, registrar)

On the other hand, some participants criticised this practice and found it to be malpractice and inappropriate:

“No, this is a malpractice and abuse [regarding the use of combination prophylaxis post-operatively]”.

(P9, Senior registrar)

SAP duration and broad-spectrum antibiotic misuse

Participants also reported that a combination prophylactic regimen was typically administered for three days, reflecting the average length of hospital stay during postoperative care. Additionally, some participants reported that in cases of complications, the duration of prophylaxis could extend up to seven days postoperatively. When asked why they continued antibiotics beyond surgery, most participants explained that this practice was based on their belief that prolonged prophylaxis helps prevent SSI during the patient's recovery period. This perception was reinforced by departmental routine and senior influences rather than guidelines recommendations, reflecting the preventative

approach culture discussed in section 4.3.2.2.2.3 and hierarchical influence of seniors described under section 4.3.2.3.2.3.

One participant explained:

“Yeah, regardless the cause, regardless if it's a simple or complicated surgery, they usually give me orders about putting the patient on Rocephin [ceftriaxone], Clexane [enoxaparin] and Flagyl [metronidazole] within three days or sometimes if they found that patient develop a fever or any other complication, like not passing motion or vomiting or any other deterioration the patient... they just completed to seven days.

(P5, Assistant registrar)

When participants were further asked why this practice is common, they attributed it mainly to habit, experiential learning and senior influence rather than to guideline recommendations. This was discussed under section 4.3.2.3.2.4 and 4.3.2.3.2.3.

Another participant acknowledged that this routine practice is unjustified and that they prescribe this combination prophylactically for three days without a clear justification, but persisted because it had become normalised within their hospital:

“Please give prophylactic antibiotics for a day or up to three days just, just in case there is no clear reason I mean, it's just their practice..... they prescribe for three days and for Rocephin [ceftriaxone] 1 gram and for the Flagyl [metronidazole] 500 milligrams, both of them TDS.”

(P4, Assistant registrar)

For some participants, postoperative prophylaxis was considered necessary even on discharge, particularly when following local hospital protocols. This reflected a hospital culture of prolonged SAP rather than patient-specific decision-making, which are discussed further under section 4.3.2.3.1.2.

One participant stated:

“Duration. You mean? I think it is. It’s for all seven days to go for seven days to give antibiotic 2 IV and to continue oral the patient at the hospital I think no need for oral just to IV me and to continue oral at home.”
(P12, registrar)

Overall, the prolongation of SAP duration post-operation was mainly driven by perceived infection risk, habit, and peer influence rather than guidelines recommendations. This practice reflects both a behavioural norm within departments and a defensive prescribing culture, which are explored further under Sections 4.3.2.2.1 and 4.3.2.2.2.3.

Uncertainty in allergy management

Participants highlighted difficulties in prescribing SAP for patients with penicillin allergies. Many expressed uncertainty about the best alternative antibiotic due to concerns about the resistance and efficacy of commonly used options such as clindamycin. One participant explained:

“Sometimes, sometimes....the efficacy of clindamycin is not perfect in this country, many organisms are not sensitive to clindamycin so that if patients are sensitive to amoxicillin, or Augmentin, or cephalosporins,

there are some difficulty to get the suitable antibiotics [for allergic patients]”

(P13, Consultant)

There was no consensus among participants on the preferred alternative for penicillin-allergic patients. Several antibiotics were mentioned, including vancomycin, co-amoxiclav, gentamicin, clindamycin, and erythromycin. One participant described their approach:

“Yes. If there is an allergy, I usually go for the anaerobic, the Dalacin [clindamycin], which is the most common one we use and gentamicin, so Dalacin and gentamicin.”

(P10, senior registrar)

Antimicrobial resistance awareness

Participants varied in their awareness of AMR. Although some senior clinicians appeared more familiar with the concept of AMR due to their broader clinical exposure, this did not necessarily translate into greater concern. Participants noted that resistant cases were relatively infrequent in OB/GYN practice, which led both junior and senior clinicians to underestimate the importance of AMR in the context of SAP.

“It's not common to see resistance with antibiotics in many cases. See resistance, but it is once a case every month, once every two months after. So, we don't think this, yeah, very, very big problem.....we don't take this seriously most of our doctors don't take this seriously.....also....They don't think that giving antibiotics for more days will cause resistance [regarding prolonging SAP duration]”

(P10, senior registrar)

In contrast, other participants demonstrated a greater awareness of AMR and its clinical and public health consequences. Some reflected on their previous training or experience with resistant infections, particularly during medical rotations, and acknowledged its growing relevance in both global and local contexts.

“Yes. When we were in the medicals, the medical field or medical rotation, I saw so many patients with multi-drug resistance, and I saw so many patients with urinary infections, and there are multiple drug resistance..... In recent years, I've seen so many brochures around. And the healthcare talking about the antibiotic resistance, and I think it's really a big issue.”

(P4, Assistant registrar)

Some participants pointed to the abuse and overuse of antibiotics in public and prescriber behaviour contributing to AMR. They were also aware that antibiotic misuse was observed when treating viral infections in Kuwait.

“Yeah because, any, any, any person taking some runny nose, you know he will start an antibiotic. Even in pregnant, she goes to a clinic or something. I will take antibiotics, and it's a viral infection. Why need for? Well, except something like.”

(P12, Registrar)

This practice has led to shifting prescribing behaviour due to increased resistance, escalating the selection to last-line antibiotics to combat the spread of infection.

“We need to change the antibiotics. Now, we are receiving some patients. Who usually would have responded to clindamycin or

whatever antibiotics, simple antibiotics, as we mentioned? Then now recently, I realised that we have to shift to meropenems for most of the patients. This is because of resistance to other antibiotics, which are effective from the microbiological point of view.”

(P8, Senior registrar)

Most participants attributed inappropriate SAP prescribing to a general lack of knowledge among doctors regarding SAP protocols and appropriate antibiotic use. However, in most cases, they refer to the wider medical community rather than admitting their own knowledge gaps.

“This is happening to me [according to what he believes] is due to lack of knowledge.....”

Again, he said the reason for inappropriate prescribing:

“Maybe the problem is a doctor..... Maybe he has no knowledge.”

(P3, senior registrar)

The lack of knowledge was highlighted as a significant issue that must be addressed to improve SAP prescribing in Kuwait. Participants emphasised the need for comprehensive education and awareness initiatives targeting all levels of healthcare professionals through lectures and courses instead of leaflets. As one consultant explained:

“I think it's the first is the knowledge [knowledge as a main barrier] that means to have the information, and I think also saying there are not many people talking about that really only, I think like there are leaflets only, and I feel there should be some courses or lectures regarding antibiotics and should include all that we are talking about the OB/GYN

you should take, including starting from the consultant till the staff nurse.”

(P6, consultant)

Another participant emphasised the need for more lectures and professional development opportunities to address gaps in knowledge regarding appropriate antibiotic use in Kuwait. They highlighted the importance of continuous learning and training, stating.

“And this is a problem that has to do with a lack of knowledge. You have to do some drills about this. Do lectures and encourage people to go to study.”

(P3 senior registrar)

This subtheme showed that participants recognised the general purpose of SAP, yet many demonstrated limited knowledge regarding appropriate timing, duration indication and antibiotic selection. The preference for broad-spectrum antibiotics, uncertainty regarding allergy management, and limited awareness of AMR underscore the vital psychological capability gaps that lead to inappropriate SAP prescribing.

4.3.3.1.4.2 Clinical decision-making in SAP prescribing (Barrier and Facilitator)

The clinical decision-making process emerged as a critical aspect of psychological capability influencing SAP prescribing. While many participants adhered to guidelines as a starting point, their decisions for SAP prescribing

were influenced by a combination of personal clinical judgment, patient-specific factors, and knowledge of guidelines, often leading to variability in practice among healthcare providers.

Use of clinical judgment over standardisation (Barrier and Facilitator)

Participants highlighted the significant role of their clinical experience and knowledge in deciding which antibiotics to prescribe and the timing of administration, emphasising their goal to provide optimal patient care. Guidelines serve as a foundation but are often modified for specific situations, emphasising the need for contextual decision-making in SAP prescribing.

“It is our practice because we find some patients have some infection febrile and in pre-operative time around the time of surgery, especially the first day if prolonged surgery even laparoscopic, we can cover with even oral antibiotics.”

(P13, consultant)

“You can deviate little, right? Deviate little to the benefit of the patient.”

(P2, registrar)

Patient-specific risk assessment (Facilitator)

Patient-specific factors were frequently cited as key determinants in SAP prescribing decisions. Participants reported that they tailor their prescribing practice based on the individual patient's risk profile, particularly for high-risk patients. High-risk patients were identified as those with fever, diabetes, obesity, prolonged rupture of membrane or immunosuppression. These factors

often led to more aggressive antibiotic prescribing to minimise the risk of postoperative complications. One participant explained:

“Long time rupture of membranes... OK, So we are [afraid] for chorioamnionitis, which is inflammation of the amniotic and placenta like this this patient is at high risk of developing puerperal sepsis, so this patient should be covered with proper antibiotic postpartum.... maybe for five days to prevent the puerperal sepsis, which may be lethal in some cases. Severe infection in the endometrium...OK, Maybe I have one patient who also has uncontrolled blood sugar, this is a higher risk for sepsis, and after the infection after delivery, you should cover about three to five days with antibiotics. In this situation, we continue the ceftriaxone [Rocephin] 1 gram BD for three days..... Prophylaxis will continue for two to three days.... also, there is an important point that obese patients, obviously high BMI, are at higher risk for wound infections.”

(P3, senior registrar)

Professional autonomy and responsibility (Barrier)

A few participants described the importance of autonomous, knowledge-driven decision-making. While this demonstrates a sense of professional responsibility that influenced their decision-making process, ensuring that prescribing aligned with their clinical knowledge and experience alone, disregarding guidelines or patient influence. One participant stated:

“Prescribing the medicine is the doctor's decision, maybe the patient hopes or dreams, but it's the doctor's decision. So I try to convince the patient, I try to explain But I will not make decisions that is not oriented with my knowledge and experience”

(P2, registrar)

This could reflect a sense of strong accountability, but it may limit the opportunity to standardise the SAP prescribing in Kuwait

Postoperative prophylaxis decisions (Barrier)

The practice of postoperative antibiotic use varied among participants and was strongly influenced by perceived patient risk and clinical condition. When asked why they prolong antibiotics after surgery, many explained that they believed extended courses could reduce SSI and postoperative complications. Several participants described prescribing antibiotics for three to seven days postoperatively, often combining agents to include anaerobic coverage. This practice was usually justified by perceived infection risk rather than microbiological evidence-based rationale, reflecting the preventative mindset described under section 4.3.2.2.2.3 and the habitual prescribing of a broad-spectrum regimen described under section 4.3.2.1.2.1.

*“Sometimes they give [to high-risk patients] Rocephin [ceftriaxone],.....and sometimes if they suspect there is a further complication, they add Flagyl [metronidazole] to the same formula.
(P5, Assistant registrar)*

Some participants supported postoperative prophylaxis but limited its duration in routine cases, reserving prolonged antibiotic use for cases where infection or complication was suspected. However, this justification reflected a misunderstanding between prophylactic and therapeutic antibiotic use, as prolonged postoperative courses contradict international SAP guidelines recommendations (see section 4.3.2.3.1.2):

“For C-section, we give antibiotics Uh, prior to the operation, and we give, I believe, one dose as far as I remember, one dose after the operation for all cases, but if there is an infection, if there is infection in the baby or in the mother, we continue for three to five days.”

(P10, senior registrar)

Modifying guidelines based on context (Barrier and facilitator)

While guidelines were acknowledged as valuable resources, participants noted that they often underwent modification based on specific clinical situations. Healthcare providers used their clinical judgment to adapt guidelines to better suit patient needs and prevent complications. As one participant explained:

“We have to modify these guidelines according to the nature of our patients.”

(P3, senior registrar)

Protocol adherence (Facilitator)

In contrast, some participants adhered strictly to hospital protocols, particularly those recommending narrow-spectrum antibiotics, and emphasised the effectiveness of these protocols in minimising infections:

“Cephalosporin [cefazolin, a narrow-spectrum antibiotic], and we don't have many patients with infection or complications that we need to change this protocol.”

(P9, Senior registrar)

In summary, clinical decision-making was shaped by both individual clinical judgment and institutional guidance. Although some patient-specific clinical

judgment was appropriate, the lack of standardisation and inconsistent implementation of guidelines contributed significantly to the variability in practice.

4.3.4. Theme 2: Motivation

The COM-B framework's motivation component included four subthemes categorised into two subdomains (automatic and reflective motivation). These subthemes explored factors such as punishment and incentive, habitual practice, beliefs about antibiotic efficacy and a preventative approach to prescribing.

4.3.4.1. Subdomain: Automatic

4.3.4.1.1. Incentive and punishment (Barrier and facilitator)

The role of incentives and penalties in influencing SAP prescribing emerged as a key aspect of automatic motivation. Participants highlighted a lack of accountability, insufficient appraisal systems, and a punitive culture that ultimately discouraged consistent adherence to protocols.

Lack of accountability and enforcement (Barrier)

Participants highlighted the absence of a structured appraisal system to reward compliance with protocols, as well as the lack of penalties or legal enforcement for non-compliance. These gaps were viewed as significant barriers to ensuring responsibility, with some suggesting the introduction of appraisal and penalty systems to promote adherence and reduce inappropriate prescribing behaviour.

“Because, like as I told you, there is no blame if they do not follow....like nobody tells him why you prescribe this”

(P9, senior registrar)

The same participant elaborated that some doctors perceived guidelines as optional advice rather than mandatory instructions. This perception was attributed to the lack of enforcement mechanisms, as well as the absence of consequences for failing to follow protocols:

“Well, It's an advice. It's not uh...a must, the protocol if somebody will not follow it he may not be blamed.”

(P9, senior registrar)

Calls for positive reinforcement and appraisal systems (Facilitator)

Several participants emphasised the importance of introducing appraisal systems to improve prescribing behaviour. They suggested that recognising and rewarding adherence to guidelines would motivate doctors to comply, while punishing measures might have the opposite effect, leading to defensive or overly cautious practices.

“If I am appraised for what I am doing, I will keep doing it. You will encourage others to do it. But if you are going to punish me, I will follow whatever you're doing. If you wrote it wrong, if it's appropriate or not, I will follow it. So, is it your target that you want me to follow the policy? Or just to make sure that it is followed and it's done right. It's the different objectives.”

(P8, Senior registrar)

While some participants agreed that there was no formal accountability mechanism, others described an informal culture of criticism and punitive accountability when complications occurred. Participants explained that prescribing decisions were often retrospectively questioned following post-operative infections, which encouraged defensive prescribing behaviour rather than a supportive learning culture. One participant described how prescribing practices were influenced by concerns about being criticised for not prescribing post-operative antibiotics, particularly within senior-led clinical environments. The participant also perceived that public hospitals placed greater emphasis on punishment than positive reinforcement for guideline adherence. Older-generation prescribing practices were viewed as contributing to this culture (see section 4.3.2.3.2.4). Participants therefore supported the introduction of appraisal systems that recognise and encourage adherence to hospital policies.

“Yes, it’s the appraisal. Have you heard about the appraisal committee? It’s in KFC. It is everywhere. Yeah, it’s never in our practice.....,but I was not sure if there was a policy, and if I followed the policy right, even if mistakes or adverse effects happen, I should not be punished for it. But socially, our culture is that punishment is the most important part... when I got an infection..... Why didn’t you give her a post-op antibiotic?..... The old school of thinking is that whenever you breach, it’s easier to punish you rather than advise you.....”

(P8, Senior registrar)

This informal punitive culture appeared to mainly influence the defensive prescribing behaviour (section 4.3.2.2.2.3) where fear of blame or litigation led prescribers to overprescribe antibiotics “just to be on the safe side”.

Mixed views around the punitive approach (Barrier and Facilitator)

On the other hand, some doctors believed that the lack of a penalty system led to irresponsible prescribing and overuse of antibiotics. They recommended implementing a punishment system to discourage doctors from freely misusing antibiotics.

“Perhaps there are no penalties on people using this antibiotic. This is something we can... Yeah, if there are penalties on the liberal use of antibiotics, this would be something helpful.....You know, penalties like the reducing the salaries or by making problems for the doctor to give antibiotics Who don't stick to the protocol.”

(P10, registrar)

In contrast, other participants emphasised the need for follow-up and feedback rather than punishment, advocating for a more constructive approach to identify the root causes of guideline deviation. They believed that understanding the underlying problems would help improve compliance in the future. One participant explained:

“There should be, like, I don't want to say, punishments. But I mean, there should be follow-up, and if it is not prescribed well, you have to identify this problem. Why is it not prescribed? Is there a problem in the availability of this antibiotic? is there a problem with the doctors? Do they forget to write? OK. Or maybe, uh. They do not understand the protocol well if there is any problem?”

(P3, Senior registrar)

In summary, while some participants considered penalties as important deterrents, others supported a more positive system, such as the appraisal

system, to improve guideline adherence. This highlights the need for a balanced intervention that supports responsible prescribing by recognising adherent prescribers without relying solely on punishment.

4.3.4.2. Subdomain: Reflective

4.3.4.2.1. Beliefs about antibiotic efficacy and infection prevention (Barrier)

Participants showed varied beliefs regarding the effectiveness of antibiotics and their role in preventing infection. While some recognised the success of current SAP practice of prescribing broad-spectrum antibiotics in reducing surgical site infection, others witnessed the effectiveness of narrow-spectrum antibiotics in reducing the rate of post-op infection. One participant emphasised the low rate of post-surgical wound infection in Kuwait, indicating confidence in and acceptance of current practice:

“In Kuwait, we don’t have too much post-surgical wound Infection or mild, mild infection that doesn’t need to be re-admitted.”
(P2, registrar)

The preference for broader-spectrum antibiotics, particularly third-generation cephalosporins, like ceftriaxone, was commonly cited among participants. They justified this choice by highlighting its wide coverage, low cost and perceived effectiveness in open surgery:

“Third-generation it’s more broad-spectrum and covers more organisms, and you know it’s open surgery; it’s preferred as a

prophylaxis. The rate of wound infection it's much more or less than first generation."

(P12, Registrar)

Some participants believed that the use of antibiotics post-surgery, especially the third-generation cephalosporins (considered broad-spectrum antibiotics) with anaerobic coverage [metronidazole], could be beneficial in preventing post-operation complications because they frequently deal with genital organs which could be more prone for anaerobic infection.

"Yeah, it's it's preferred just to combine it, combine it with the Rocephin [ceftriaxone] just to cover all the Uh....all the infections, and to avoid all the complications."

(P5, Assistant registrar)

Some participants justified this due to the uncertainty in identifying specific organisms responsible for infection, which reinforced their preference for broad-spectrum antibiotics prophylaxis. One consultant explained:

"Our department. Well, yeah, I am with broad-spectrum antibiotics...Say when we are doing surgeries like hysterectomy or myomectomy, We don't know about the specific organism because we couldn't take... like we didn't take..... like wound swabs or culture to see the organism to give the specific for each one [bacteria]."

(P6, Consultant)

On the other hand, some participants emphasised the effectiveness of a single dose of narrow-spectrum antibiotics, such as cefazolin, a first-generation cephalosporin, in preventing infections. Nonetheless, they still expressed a

personal preference for broader-spectrum antibiotics. Some clinicians described this as a defensive approach to reduce perceived risk, even when recognising that it deviates from guidelines.

“No, I am with it, and we are using it, and we have a very low infection rate surgical site infection, so it's achieving success [Talking about the use of cefazolin]. But if I'm the one who's going to choose the antibiotic, I would go for the broad spectrum first-generation or second-generation Rocephin [ceftriaxone] or something like that.”

(P8, Senior registrar)

This defensive rationale was further reinforced by the belief that effective alternatives remain available if resistance develops. And despite their preference for broad-spectrum antibiotics, participants acknowledged the potential for increased resistance. One participant discussed the availability of alternative options in cases of resistance, emphasising the broader-spectrum antibiotics, which are considered one of the last resort antibiotics, which are the carbapenem antibiotics:

“Almost the same coverage, but if there is resistance from Rocephin [ceftriaxone], still we have the weapon of Meropenem [agent of carbapenem], it's still a version that is effective. Maybe we lost some of the effectiveness of the cephalosporin, but Meropenem still we have it.”

(P8, Senior registrar)

Such beliefs may indicate limited appreciation of antimicrobial stewardship principles and overreliance on the availability of broader-spectrum antibiotics as a safety net. However, some participants did not observe superiority in using broad-spectrum antibiotics over narrow-spectrum ones for routine

procedures and for healthy or high-risk patients (such as uncontrolled diabetes, immunocompromised or obese). They noted that the outcomes were often similar for both types of antibiotics and expressed concern that the overuse of broad-spectrum antibiotics could potentially lead to an increase in resistance.

“For my practice, I didn’t see a major difference or more benefits [Of using broad-spectrum over narrow spectrum] even in the risky patients, but the usual patient, the regular routine operation, the same result for both.”

(P12, registrar)

These findings highlight the conflict between awareness of best practice and habitual prescribing behaviour. Furthermore, while some participants recognised that narrow-spectrum antibiotics are sufficient, their preference for broad-spectrum antibiotics reflected fear of post-operative infection and a defensive culture of thinking that more coverage means better care.

4.3.4.2.2. Change in prescribing behaviour (Facilitator)

A few participants reflected on how their prescribing practice had evolved over time, describing greater awareness of emerging evidence and changing infection patterns. When participants were asked about certain prescribing practices identified in the PPS, such as prolonged SAP courses, inappropriate timing and overuse of broad-spectrum antibiotics, some participants acknowledged that certain practices may no longer reflect current evidence. Participants explained that ongoing reading, exposure to newer evidence, and

increased familiarity with guidelines had influenced how they approached prescribing decisions. Some described becoming more cautious about the routine use of broad-spectrum combinations, particularly when local microbiological patterns did not support anaerobic coverage. However, these views appeared to reflect individual awareness and reflection rather than a consistent or widespread change in practice, as substantial gaps in prescribing knowledge and practice remained evident across participants.

For example, one participant reflected on how increasing awareness of local microbiological trends had influenced their approach toward empirical anaerobic coverage:

“Recently, no. Because it has been discovered that it is not true that most of the infections. The cases that went home and came with the surgical site infection. Anaerobes was not the most of it. However, if we find that anaerobes with the culture we start metronidazole. Sometimes, we start empirically, and when we see the culture, we just stop. But what I’ve been seeing over the past few years is that anaerobes are not the big portion. Most of the infections are E. coli, Klebsiella that are getting to the front lines.”

The same participant emphasised the importance of updating prescribing practice based on new evidence, highlighting the need for adaptability to address changing trends in infections:

“If new evidence appears. If I realise that my patients or in our unit at least, though we are following the policy, we have an increase in surgical site infection, I would raise this issue to the department to consider it.”

(P8, Senior registrar)

4.3.4.2.3.Preventative approach to prescribing (Barrier)

Participants highlighted a preventative approach in their prescribing practice, emphasising the importance of avoiding potential complications and minimising the risk of postoperative infections. This approach often involved prescribing antibiotics proactively, particularly for high-risk patients or complex surgical cases, with the goal of reducing the likelihood of adverse outcomes. However, this strategy sometimes resulted in the overuse of antibiotics beyond standard guidelines, reflecting an imbalance between clinical judgment and evidence-based recommendations. Participants frequently emphasised that patient safety was a central concern in their prescribing decisions. Whether in public or private hospitals, doctors viewed ensuring the patient's safety as their primary motivation. As one participant explained:

“And every doctor, either in private either a public hospital they want the safety of the patient from his scope of view.....

(P2, registrar)

Participants expressed a sense of responsibility for prescribing SAP, most felt that the surgeon or attending physician is primarily responsible for the safety of the mother and the baby in obstetric cases. A participant explained:

“we are responsible all the time for two the mother and the baby and your mission is to deliver a healthy mother and get a good baby this is our problem all the time here.”

(P3, senior registrar)

Moreover, doctors also felt personally accountable for the outcomes of the surgical complications or side effects:

“Doctor think he is responsible for the side effect of the surgery and the complications of the surgery”

(P2, registrar)

This often led to a tendency to overprescribe antibiotics, as doctors believed it was better to be overly cautious to avoid potential complications:

“Maybe they think wrongly that like this, they are on the safe side, and this is safe for the patient.”

(P9, Senior registrar)

Fear of litigation and blame (Barrier)

Another significant factor influencing SAP prescribing practice was the fear of being blamed by patients, seniors, or hospital administrators for any postoperative infections. Participants expressed that this fear often drove their decisions to overprescribe or deviate from guidelines:

“No one wants to be blamed from anyone, from patient to from senior from consultant, from either”

(P2, registrar)

“I explained to you doctors are afraid of the complications and medical-legal issues.”

(P6, consultant)

The issue of litigation was particularly pronounced in obstetric cases, where doctors worried about legal consequences and patient complaints:

Also, in our practice, there is a big problem usually ...globally, by the way... in obstetrics, especially medical-legal issues, play a big role..... Medical-legal...yes.... There is too much litigation, and the complaints maybe happen.... The patient will go and complain”
(P3, senior registrar)

This responsibility placed on doctors extended beyond clinical decisions to include the psychological burden of possibly being blamed by patients for complications or infections. One participant described this burden:

“I was carrying the risk of that I could get a surgical site infection and I will be investigated. And then the old school will tell me why you didn't do so and so and so. So, it was something like a psychological burden that was put on my shoulders, but I managed to pass through it. This is personal variations, and you cannot blame someone for not doing so.”
(P8, senior registrar)

Private sector pressure (Barrier)

In addition, participants noted differences in prescribing practice between private and public hospitals. In the private sector, although the workload is not heavy, doctors often feel pressure to overprescribe to maintain their reputation, as patients tend to hold individual doctors responsible for the outcomes rather than the hospital itself. A participant explained:

“In private, the patients come for your name, and will be under your responsibility. Not like governmental hospital, it will be under the responsibility of the department of the hospital, so the doctors may be

like fear from like infection, postoperative infection or something is telling like OK just let me to prescribe the antibiotics to be safe. It means it doesn't complication, and especially in private section, you know, have something complication and patient paid money. So why haven't? So why don't you give me antibiotics? Why don't try.....So, the doctor is going for the easy way to prescribe.....And I feel...Most of the doctors or physicians in privates are doing the same."

(P6, Consultant)

Another participant highlighted the patient's expectations and blame on the doctor in the private sector:

"In the private they give everything they can give.....Why? Because the patient later can blame them. Why? You give me only this? Why you did you not give me?"

(P9, senior registrar)

Public sector culture (Barrier)

In contrast, doctors in public hospitals faced heavy workloads and different pressures, such as avoiding blame from their seniors or administrators if postoperative infections occurred. Participants frequently described overprescribing antibiotics as a "safe" approach to avoid surgical complications or blame. This practice was attributed to a lack of strict implementation of guidelines, leading to autonomic prescribing habits:

"We freely give antibiotics. Uh, so there isn't really a rule or a guideline to not prescribe it. So we see commonly it's better to prescribe. That's the common idea It's better to prescribe rather than not, because if a patient comes even after a simple procedure comes with an infection or the causes because she didn't receive antibiotic postal."

(P11, registrar)

Some participants acknowledged that they continued prophylaxis even when there was no clear indication, such as uncontrolled blood sugar, obesity, or prolonged rupture of membranes, or sometimes without any evident reason for continuing SAP after the operation.

"It should be there is a reason for this ... This like ... As I told you, maybe patient is uncontrolled the blood sugar.... Uncontrolled blood sugar this is a big problem for us during incision... So we should continue prophylaxis in obese patient, maybe the patient has prolonged rupture of membrane already there is infection in the uterus. So we have to continue, maybe they accidentally discovered there is pelvic inflammatory disease, so we should continue. Of course. And maybe also for nothing, just prophylaxis....yeah, like this."

(P3, senior registrar)

Despite guidelines recommending brief SAP courses (American College of Obstetricians and Gynecologists, 2018; National Institute for Health and Care Excellence (NICE), 2019), this practice of extending antibiotics "just in case" represents a defensive or precautionary practice rather than an evidence-based practice. When asked why, some participants acknowledged that the guidelines clearly stated that no postoperative antibiotics were necessary for low-risk patients, while others admitted to deviating from this recommendation out of fear of complications from infections, especially in complex or high-risk cases.

"According to the guidelines, there are no post-operative antibiotics. No need if the patient is at no risk for anything..... No need for postoperative antibiotics."

(P3, Senior registrar)

In summary, reflective motivation was influenced by participant's beliefs about the efficacy of antibiotics, the development of knowledge, and a strong preventive mindset. Broad-spectrum use was justified based on perceived high risk, patient expectation, and habitual practice, despite their awareness of AMR and guideline recommendations. Over time, many participants described shifting their prescribing practice towards adherence to evidence-based practice. However, prescribing practice was primarily driven by concerns over clinical complications and legal litigation, particularly in the private sector, which resulted in excessive antibiotic use.

4.3.5. Theme 3: Opportunity

The COM-B framework's opportunity component included seven subthemes, categorised into two subdomains (social and physical opportunities). These subthemes explored factors such as cost, availability, patient influence, traditional practices, guidelines, and policies.

4.3.5.1. Subdomain: Physical

4.3.5.1.1. Drug cost and availability (Barrier and facilitator)

Many participants highlighted that drug availability and cost could be influencing factors affecting prescribing behaviour in Kuwait. This leads them to use alternative antibiotics that do not align with the guidelines. One participant explained how stock availability made them change their prescribing from narrow-spectrum antibiotics to broader antibiotics:

“Maybe that availability of the antibiotic..... for example, where I'm giving the on one of the amoxicillin, but now we should give Rocephin [ceftriaxone] instead because we don't have the amoxicillin for a long time. I don't know if they are the same, but it's not for operations like this.”

(P7, Assistant registrar)

However, this response also shows limited pharmacological knowledge among clinicians regarding antibiotic equivalence and spectrum activity. Such uncertainty reflects the broader knowledge gaps discussed earlier in section 4.3.2.1.2.1, particularly regarding antimicrobial classification and appropriate selection.

Occasional drug shortage (Barrier)

However, some participants explained that drug shortages are not common in Kuwait but can occur occasionally. For instance, during the COVID-19 pandemic, shortages in antibiotics were reported, which impacted prescribing practice. One participant shared:

“Sometimes it happens, but it's very rare that economic issues or financial issues. It happened during the COVID. Some medications were not available in the stores. So, we had to change to others. And it was common medications that we used; Rocephin [ceftriaxone] was one of them. Zinacef [cefuroxime] was one of them. For some reason, it was not available in the stores, so we had to change the practice.”

(P8, Senior registrar)

Another participant attributed the recent antibiotic shortages to the global impact of the COVID-19 pandemic, which disrupted manufacturing processes:

“Also, there is really a big problem at the moment. Right after COVID-19,. There is a problem in manufacturing everything. Maybe this is a problem, yeah, and really, this problem started to appear after COVID-19.”

(P3, senior registrar)

A similar view was shared by another participant, who explained how international shortages affected local prescribing:

“Yes, in some situations, according to these antibiotics, maybe also they are prescribing the UK antibiotics, which are not available here, but we have to use the substitutes.”

(P3, senior registrar)

In contrast, one doctor emphasised that Kuwait's wealth and the Ministry of Health's support have ensured that resources for SAP prescribing are readily available, eliminating financial or resource-related barriers.

“I don't think there's any barrier to prescribe but I mean its easily available, money is not a problem because these things we have to keep coming from many things in consideration. It's the availability and it's the monetary thing. But Alhamdulillah [thank God], we haven't come across such barriers as of now I mean I haven't come across.”

(P1, registrar)

The same doctor suggested that the non-compliance rate highlighted in the PPS might be attributed to occasional shortages of antibiotics or due to specific doctor's orders, which could explain some instances of non-compliance. They also believed that the actual compliance rate should generally be higher than what was reported in the PPS findings. As the doctor explained:

“80%, I won't say 100 would be a bit too much. But 80 to 85% of compliance is there, 10 to 15% non-compliance would be either there's non-availability of the medicine, or there has been.....umm.. the instructions have not been given. But most of us, I mean, I've been here for almost four to five years. I see all of them as very compliant with the protocols the local protocols.”

(P1, registrar)

This belief that compliance was higher than the PPS findings likely reflects a personal experience within their own hospital rather than actual audit data. It may also indicate a defensive justification of personal or hospital practice.

Drug cost in the public sector (Facilitator)

In the public sector, cost was not perceived as a major factor influencing prescribing behaviour, as all medications are provided free of charge to patients. Doctors noted that patients are unaffected by the price of antibiotics. However, one doctor in the public sector explained that they avoid prescribing expensive antibiotics unless they are needed for more serious infections to minimise resistance. As one participant stated:

“Rocephin is very expensive, we keep it for the cases with the infection, so it's not to have resistance.”

(P10, consultant)

Drug cost in the private sector (Barrier)

In contrast, the issue of cost was more prominent in the private sector, where it was described as potentially profitable for hospitals and influenced by

patient's willingness to pay for better medical services. One doctor highlighted a concerning prescribing practice in the private sector:

"I think in the private sector, there is a problem..... Maybe this is the most expensive antibiotic just to prescribe something expensive..... [when asked what he meant by this] To take money, yes..... [when asked if they ever faced cases like this] I always face this; patients are putting on Meropenem, it's very expensive, so they will pay..... For anything and maybe patient to have anything, they prescribe strong, very strong, broad-spectrum and very expensive antibiotics."
(P3, Senior registrar)

Another participant echoed this issue, pointing out how some private-sector doctors justify prescribing costly antibiotics, leaving the financial burden entirely on the patient:

"It's a problem of the patient to provide money for antibiotics. No problem, doctor. So I will write a long prescription full of antibiotic and if the patient can't afford it, his problem."
(P2, Registrar)

One participant highlighted an issue in the private sector regarding reliance on pharmacists, explaining that when doctors prescribe a generic antibiotic, private pharmacies often provide the most expensive option available. As the participant stated:

"Yeah, when we write the generic names, as I told you, the pharmacist gives us what is available and also according to the price; sometimes, it's given the highest price."
(P6, consultant)

This reflects that antibiotic prescribing within the private sector was largely profit-driven rather than guideline-driven. Although the antibiotic itself may not change when prescribed generically, financial incentives strongly influence antibiotic selection and overall prescribing behaviour. Such practice can lead to the unnecessary use of costly or broad-spectrum agents, prioritising profit over clinical appropriateness.

On the other hand, some participants suggested that this behaviour in the private sector could be driven by a desire to minimise post-operative complications and ensure patient satisfaction, which are directly linked to profitability and reputation. Doctors in the private sector were perceived as more cautious and inclined to use broad-spectrum antibiotics to minimise any risk of infection that could lead to patient dissatisfaction, complaint or loss of trust with the institute.

“Yes, because the private today, try to minimise the complications as much as possible. They have fewer patients than the..... they have fewer patients than the public sector. The public sector will try to reduce the cost but the private sector the patient pays. So you want you want to don't want any problems with the patient in the private. So they give a broad spectrum antibiotics.”

(P10, registrar)

However, not all participants were certain about the extent to which financial incentives influence prescribing in the private sector.

“But I would say maybe money would play a part of it but I'm not sure because I have no experience at all in the private.”

(P11, registrar)

This tendency toward overprescribing in the private sector is further described under the defensive prescribing behaviours in section 4.3.2.2.2.3.

4.3.5.1.2. Guidelines and policies (Barrier and Facilitator)

The role of guidelines and policies in influencing SAP prescribing practice was identified as one of the major subjects influencing SAP prescribing.

Guideline accessibility (Barrier)

Participants highlighted mixed experiences regarding the accessibility and distribution of local guidelines. While some participants reported that guidelines were easily accessible and provided in digital formats or hard copies, others noted challenges in obtaining them, particularly for junior doctors. Some doctors shared their positive experiences, saying:

“Yeah, we have access to it. We have a complete system, and we have been emailed all the protocols. We have a book which is in every department it's very recent.”

(P1, registrar)

Another participant stated:

“Yes, It's available on our mobiles, So, that uh....We have PDF available on our mobiles, every doctor in the department, it's available on his mobile.”

(P3, senior registrar)

On the other hand, junior doctors have faced challenges in accessing these guidelines.

“As I know, no, they usually don't give us the guidelines, I mean, they don't provide with the guidelines of the hospital itself.”
(P4, assistant registrar)

Another participant also elaborated:

“Uh, not that easy, but if you ask for it, you will get a copy..... It's not available in each ward or each OT [operating theatre].... You have to ask for it.”
(P7, assistant registrar)

Improving guideline accessibility (Facilitator)

Participants proposed several ideas to improve the accessibility of the guidelines, such as using online websites or through hard copies in each ward or in patient's files.

“I prefer it in papers you know, just to keep it in the ward, give it to the staff nurse head nurse, this is our guideline.”
(P5, assistant registrar)

“Easy accessible. It means if it is on the MOH [Ministry of Health] site, the official site, everyone can have a look for that, and they can follow the rules.”
(P6, consultant)

Call for a national guideline (Facilitator)

Regarding guideline standardisation, most participants emphasised the need for national guidelines to unify SAP prescribing practice across public and private hospitals. They reported considerable variability in current practice, which they attributed to the use of different hospital-specific guidelines and the diverse medical training backgrounds of clinicians, many of whom were trained abroad, where protocols often differ from those followed locally. The implementation of standardised national guidelines was perceived as essential for ensuring consistency in patient care and bridging the gap between institutional and individual prescribing behaviours.

As one noted:

“At final we make one protocol matching for us, if patient to come to for example, from Hospital A to Hospital B or Hospital C, I think the patient receives the same medication, same protocol, same investigation, same management pre and post-operative the I think it will be clear for all and the spread. Regarding the direct way regarding the ministry of health and all over the government.”

(P12, registrar)

Similarly, a consultant highlighted the importance of applying unified policies across all sectors

“I feel to have like Same and what we can tell you like....um... local policy It should be all over there governmental and private sector and should be applied for both. It means and should be distributed for the government and private section and all of the doctors should follow the same rules.”

(P6, consultant)

Absence of protocols in private sector (Barrier)

When asked about the reasons for the overprescription of antibiotics in the private sector, some participants suggested that this practice was due to the lack of protocols and or an overprotective approach towards their patients, as previously mentioned. This overuse was supposed to stem from a desire to offer excessive caution rather than adherence to standardised prescribing practices.

A consultant explained:

“There's no protocol in the private. Some people give, some people don't give. Not everything has protocols. You have protocols for the major things. Some people think they are giving more protection to the patient.”

(P10, consultant)

Acknowledgement of guidelines adherence benefits (Facilitator)

Participants acknowledged the benefits of adhering to robust evidence-based guidelines, including minimising errors, promoting safe prescribing practice, and reducing the rate of SSIs. Some expressed strong admiration for international guidelines over local guidelines, recognising their role in improving patient safety and overall quality of care.

As one registrar noted:

“I think minimising error, more benefit for patients, safe prescribing, safe practice.”

(P11, registrar)

Another participant commented on the broader clinical benefits:

“The benefit is to enhance the recovery of the patient, It decreases surgical wound site infection, of course. It decreases the hospital prolonged hospital stay”

(P3, senior registrar)

Guidelines implementation (Barrier)

However, they also highlighted multiple barriers to the implementation of guidelines, including a lack of clarity, resistance to change, and the absence of monitoring mechanisms and follow-up. As one consultant explained:

“Here in Kuwait, usually we do our practice. We don't. Yeah, some people, most of the people, don't follow the guidelines for the for the things I said to you because the system is not using these guidelines. It will take time to put guidelines, implement the guidelines, and make sure that the guidelines are being followed up OK and that this is not only the antibiotics but it's even the procedure With the guidelines, I think the implementation of the guidelines will take time. But what is preventing them from doing this?”

(P10, consultant)

Some participants were sceptical about the practicality and enforcement of protocols, especially in the local context:

“Like, easy to have a protocol, but I don't I. And I doubt they will follow the protocols, so I don't know.”

(P7, assistant registrar)

The need for clear updated guidelines (Facilitator)

Many participants emphasised the importance of having clear and regularly updated guidelines. They noted that unclear or outdated protocols often result in inconsistent practice and greater reliance on individual clinical judgment. Several participants raised concerns about the frequency of updates, highlighting that some guidelines had not been reviewed or revised for several years.

“We need to have clear guidelines.”

(P4, assistant registrar)

Another consultant called for more concise and accessible guidance tailored to the OB/GYN context:

“Say for us OB/GYN gynaecologists make it clear....uhh... in every guideline. Make it clear by like summary; they are just giving like a summary for what you will do and what you shouldn't do, so it's clear for all OB/GYN doctors regarding the antibiotics.”

(P6, consultant)

Policy and oversight (Barrier)

In discussing the timeliness of updates, a senior registrar reflected on how infrequently the guidelines are reviewed:

“Yes, we have [guideline], it has been published and disseminated. But maybe a few years back. I did not need to go back to it most of the time because we're used to it. But maybe I'm not sure if it was updated or not.”

(P8, Senior Registrar)

In addition to clarity and updates, several participants pointed to the need for stronger enforcement mechanisms at both national and hospital levels. They expressed that current practice lacks structure due to insufficient rules, regulations, and institutional accountability.

“I think lack of, you know, rules and regulations and guidelines. Uh, and I think that's, you know, attributed to like a hospital-based, a national-based, but mostly like, first, it starts with the ministry, and then each hospital runs slightly different than the other hospital. So each hospital has to be responsible for how the doctors and the nurses, you know, manage the patients. And I think, yeah, that's the main reason that it's not well organised. “

(P11, registrar)

In summary, drug cost and availability, along with the clarity and accessibility of guidelines, were key factors influencing SAP prescribing. Public hospitals faced minimal cost barriers and occasional drug shortages, whereas in private hospitals, profit-driven practices led to the overuse of antibiotics. Participants also highlighted the poor implementation and access to guidelines, calling for regular updates and the standardisation of prescribing practice through a national guideline.

4.3.5.2. Subdomain: Social

4.3.5.2.1. Patient influence on prescribing practices

Participants highlighted that patient hygiene and adherence to postoperative wound care instructions were key factors influencing SAP prescribing practice. Poor hygiene and inadequate wound care were commonly perceived as

contributing to postoperative infections, which in turn prompted some clinicians to over-prescribe antibiotics as a precautionary measure.

“Hygiene Yeah, wound is clean. wound swabbing wound care at home. It's a very important point for us. Maybe patient don't care about wound cleaning, taking shower, not keeping the wound dry at all times or doing many difficult movements. It's affect her wound.”

(P12, registrar)

Another participant reflected on cultural habits that may compromise hygiene in the early recovery period:

“Most of the mindset of lots of patients over here in Kuwait, especially depending upon the different areas that they belong, that you do not take a shower for the first three days So you do understand there are being exposed to a lot of body bacteria itself You know.”

(P1, registrar)

These cultural norms were perceived as a risk factor for postoperative infection, leading doctors to justify continuing SAP beyond the recommended duration. Moreover, participants noted differences in patient education levels and cultural perceptions of hygiene, especially after delivery. Some patients were believed to avoid showering for a week after the surgery to prevent postoperative infection and for faster recovery. Patient expectations regarding antibiotics played a significant role in overprescribing SAP.

“I mean many patients... they should take care of their wound, and their hygiene.....we deal with different patients and different nationalities it is a different culture from one patient to another. So antibiotic prophylaxis will be benefit at this time for this patient.”

In addition, some participants noted that a lack of education and negligence in seeking routine postoperative wound care, particularly among patients who rely on polyclinics for dressing changes, were also reported as contributors to wound infections.

“Yeah, some patients, especially the non-educated ones.... When telling them postoperative information, to go for the polyclinic to make, like daily dressing, some patients have some....negligence. So they are coming back with wound infection....So maybe because of negligence, this happened.”

(P6, consultant)

Several participants noted that patient-specific clinical risk factors, such as diabetes, obesity, and a history of recurrent wound infections, also influenced SAP prescribing. These conditions often led to extended or more frequent use of prophylactic antibiotics, regardless of guideline recommendations. While such comorbidities are recognised risk factors for SSI, extending SAP beyond the recommended 24-hour period is not supported by established guidelines, such as ACOG (American College of Obstetricians and Gynecologists, 2018). This suggests that some clinicians may misinterpret these factors as indicators for prolonged prophylaxis, reflecting a gap in knowledge regarding SAP duration.

“As I told [you], the patient risk factor,... if she's diabetic. If the patient had, like past history of recurrent wound infection. So, at that time, we are just going more with prescribing prophylactic antibiotics. And the

General hygiene of the patient, as I told you before, and whether she will do the procedure in a hospital with a clean environment or she will do the procedure in a polyclinic. But they should follow the rules, and all surgery should be done at hospitals.”

(P6, consultant)

Another participant discussed other contextual concerns affecting decision-making:

“OK, patient sensitivity, are there any endogenous infections before the patient is exposed to infection at home like the son or daughter have some infection? This will also affect the result..... It is better in emergency C-sections we need to cover with antibiotics.”

(P13, senior registrar)

Collectively, clinicians viewed these patient-related factors and cultural beliefs as justification for prolonged or unnecessary postoperative SAP, reflecting how social and cultural influences may indirectly shape prescribing behaviour (section 4.3.2.2.2.3)

Participants also highlighted how patient expectations and misconceptions about antibiotics influence prescribing decisions. Some patients expected antibiotics based on the experiences of friends or family members, pressuring clinicians to conform even when prophylaxis was not clinically indicated.

“The patient will blame... Why you don't give me antibiotic? But my friend, my sister, delivered C-section like me, and they have antibiotic and they didn't face this problem.”

(P2, registrar)

Misunderstandings around antibiotic allergies, especially penicillin, were also reported. Some patients self-report allergies without clinical confirmation, and in the absence of clear testing protocols, these claims often shape prescribing decisions.

“Yes, another factor could be the patients. I don’t think sometimes the patients are aware of what an allergy means, like a penicillin allergy.....but we take their word for it most of the time, unless sometimes if the consultant is there, then we give a test dose skin test..... But other than that, we follow the patients. Uh...Like their words, if she says she is allergic to penicillin, then we try to avoid it.”
(P11, Senior registrar)

Several participants emphasised that patient’s medical history, including prior antibiotic use and infection response, guided their prescribing decisions. In some cases, patient-specific circumstances justified deviations from established guidelines. However, such practice is not supported by well-established guidelines such as ACOG (American College of Obstetricians and Gynecologists, 2018). This suggests that such deviation is mainly driven by a lack of knowledge (section 4.3.2.1.2.1) and experience-driven decision-making behaviour highlighted earlier (section 4.3.2.1.2.2).

“As I’ve said that this patient, I have a history. I know about her. I know that she had an infection which has responded to this antibiotic in the previous surgery or recently, or she’s being treated during her follow-up for the infection. So, this will guide me with antibiotics usually.”
(P8, senior registrar)

The same participants also noted that, while they try to adhere to policies, certain patient-specific cases required modifications to standard protocols:

“Sometimes, we need to preach the policy because the policy is not available. This sometimes happens, but mainly we don't. I don't, I personally don't preach. The policy I follow the policy unless I have justification for myself.”

(P8, senior registrar)

Finally, some participants highlighted the importance of involving the patient in the decision-making process regarding SAP prescribing. Providing patients with information about the associated risks, benefits, and expected outcomes was viewed as essential for enhancing understanding and adherence.

“Yes, in my in regarding me, yes, I involve and explain all risk and the duration it's more important some patient accept some patients don't accept.”

(P12, registrar)

“Prescribing the medicine is this doctor's decision... But I try to convince the patient, I try to explain, but I will not make decisions that are not oriented with my knowledge and experience.”

(P2, registrar)

Overall, the SAP decision was strongly influenced by patient-related factors, including hygiene practices, education levels, comorbidities and expectations. These factors contributed to both defensive prescribing and deviation from guideline-based practice, as described in section 4.3.2.2.2.3.

4.3.5.2.2.Audit and feedback (Facilitator)

Participants highlighted the critical role of audit and feedback in monitoring and improving SAP prescribing. Audits were seen as an effective strategy for identifying prescribing patterns, evaluating outcomes, and addressing potential issues such as inappropriate prescriptions or adverse effects.

“Conducting audits in every hospital and then like make a big committee from the Ministry of Health to connect all these data.....This strategy will allow the revision of all medicine prescribed. What is the effect? What is the effect of this prescription? Is it a good effect or no effect? How many patients have side effects like? Allergy, like rash, like infection, like wound infection. I think this needs to be revised.”

(P2, registrar)

Participants also emphasised the value of follow-up on prescriptions to ensure compliance and identify barriers such as medication availability or physician mistakes.

“Do follow up or audit for the antibiotic prescription and the outcome.....But I mean, there should be follow-up and if it is not prescribed well, you have to identify this problem Why it is not prescribed? Is there a problem in the availability of this antibiotic? is there a problem with the doctors? Have they forget to write?”

(P3, senior registrar)

Despite the acknowledged importance of audit, several participants noted the absence of functional audit committees or feedback mechanisms in their hospitals. While such systems theoretically exist, they are often inactive or ineffective.

"Theoretically, there should be.....I don't.... I never felt that it is there"

(P8, senior registrar)

One participant stressed the importance of addressing errors immediately during the audit process, suggesting it as an opportunity for real-time correction:

"So, we should investigate why she did not receive. At the same time, this is a good chance to correct the error. The doctor will say ok we'll give it now and we'll give us 10 more minutes extra before skin incision. If this happens we are 100% sure that these patients received the antibiotics."

(P8, senior registrar)

Participants proposed several ways to improve audit and feedback systems, such as creating annual or quarterly reports, involving department heads, and fostering collaboration between specialities.

"Different ways, an annual report of our achievements of our committees, emails, maybe annual reports. In the school my kids, they have the yearbook. Why they don't do something similar. That is the annual achievement of this hospital without names, without blaming anyone. We are in 2024, no one knows what happened in 2023. No one knows about what this committee. Where is it? What did they achieve?"

(P8, senior registrar)

"Yes. Uh at the hospital level, I think you know, having like meetings with head of departments at and each department would have like a census or like reports or audits like a proof like there is a fault in the practice that we need to improve the practice. And you know having that regularly then it we would always pick up on the on the wrong and hopefully improve it."

(P11, registrar)

Participants identified barriers to audit implementation, such as a lack of collaboration between specialities, insufficient communication, and the absence of structured quality control projects.

“Uhh..I don't know. I think maybe the way the hospital runs, it's very like each speciality is separate. We don't have like, for example like a monthly meeting to combine everyone or like a census yearly census or like a quarterly census or something that is that a distributed, you know something to see like what we're doing, right what we're doing wrong and how we can change it like we're lacking all of this like no audits, no quality control project. It's just the common practice that we run.”

(P11, registrar)

Participants also emphasised the need for cross-hospital collaboration and shared statistics to identify areas for improvement and ensure consistent standards.

“Yeah, I think we should. We should be statistically included. Yeah. I mean, like in our hospital, we are doing almost per month, almost maybe 1000 deliveries. And yeah, any infection rate is less than half per cent. So I'm not sure about others statistics, do they have complication or no complication?”

(P9, senior registrar)

Participants had varied opinions on who should be responsible for the audit. While some believed it should be senior doctors, others suggested that it should involve multidisciplinary teams, including heads of departments and committee members.

"The one who was giving them the protocol. The senior doctors should be following this."

(P10, consultant)

"But it has to involve all the departments, the heads and once you involved all the heads, each head will be responsible for their own team."

(P11, Registrar)

4.3.5.2.3.Senior and peer influence on SAP prescribing (Barrier)

Participants acknowledged that prescribing habits are often shaped by the practice of senior colleagues. Junior doctors, especially newcomers, tend to follow their seniors, creating a cycle where routine practice is passed down and maintained. This reliance on senior input was emphasised as a key factor in SAP prescribing decisions. One participant explained:

"I mean, I found my senior like this medication. I would write like him. I write like this one I write for 2-3 days like him. I came to a newcomer to hospital and found the old one. Write like this I will write like this."

(P12, Assistant Registrar)

Junior doctors and assistant registrars, due to their limited experience in dealing with antibiotics, often rely on their seniors for guidance. This reliance on senior input shapes their clinical experience with SAP prescribing, gradually turning this practice into routine. One participant explained:

" I think it's because people do not really know how to deal with the antibiotics. they just learn it from the people above them. Like if I wasn't in the Kuwaiti board if I was just an assistant, I would follow the orders of my senior, and it would be a routine for me to do it."

(P4, Assistant registrar)

Many junior doctors admitted to following the preference of their seniors without challenging them, even if their practice deviated from guidelines:

“Yes. It’s not hard to get [the guideline]. Yeah, I can have it, but even if I have it, I will, like, obey that senior consultant order.”

(P7, Assistant registrar)

Senior clinicians often have the final say in prescribing practice, with their preference influencing the use of antibiotics even for routine procedures. For example, a participant highlighted how the surgeon in charge dictates the approach:

“I mean, this is not the guideline, but this is the practice in here. So the first surgeon, the one who is responsible about the procedure, he’s the one to, to tell if he wants to put prophylaxis or not.”

(P4, Assistant registrar)

The guidance from senior staff was also perceived as a source of reassurance and responsibility, particularly for less experienced doctors:

“They have more experience And they have more knowledge and responsible more responsible than on us....So we want to counsel them [consultants and their seniors].”

(P2, registrar)

The decision-making process for junior doctors often involves double-checking with senior colleagues before prescribing antibiotics:

"I have to ask and double-check with them. What? What they usually prefer [regarding the type of antibiotics], what they usually use, and then I'm gonna go with the same their way."

(P5, assistant registrar)

Participants showed hesitancy in using less common antibiotics, even when guidelines recommended them. This hesitation was due to fears of distinguishing themselves from colleagues and deviating from established practice. One participant noted:

"Umm. If it's recommended [in the guidelines], I would give it a try, but I would be hesitant as well because maybe I would be the one standing out amongst the others because everyone commonly uses a third generation rather than first generation. So yeah, I think that's that that would be the only like a challenging part. But I can certainly like go ahead and try it, since like, you know it's a guideline and the protocol a local one that I can actually like lean on and use.....So if someone sees that I'm giving Cefazolin like it would, maybe it would make them surprise like ohh why is this person using Cefazolin. Because, like we, everybody commonly uses Rocephin thinking that it is a local guideline other than Cefazolin no one is aware that there is a local guideline for the hospital."

(P11, Registrar)

Despite the strong influence of seniors, some senior registrars actively discouraged certain practice, emphasising the importance of evidence-based prescribing:

“So for me, as a senior, I advised the junior staff that no need to give it [combination prophylaxis].”

(P9, senior registrar)

4.3.5.2.4. Traditional practice (Barrier)

The persistence of traditional practice in SAP prescribing emerged as a recurrent theme, highlighting resistance to change among some healthcare providers. Participants noted that many doctors continue to rely on outdated methods, often shaped by their previous training and long-standing routines. For instance, one senior registrar explained:

“The doctors who use the metronidazole, they do not use it before surgery, ...Maybe in the past that was the usual. Yeah. And they are not updating their studies. And the international and local guidelines.”

(P9, senior registrar)

This reliance on traditional practice was further attributed to a broader cultural tendency to adhere to where they had been practising before. One consultant described:

“No, no, not it is the culture. The doctor usually does what they are practiced, and that’s...useful. So if you try to implement guidelines [new guideline] that are not practised before, they prefer to practice what they have practised. This is the culture, the way of thinking.”

(P10, consultant)

Participants observed that older generations of doctors were particularly resistant to adopting new guidelines. A senior registrar elaborated on how this generational difference impacts practice in Kuwait:

“It could be that some doctors are stuck to the old school. Or the way they learn. We are here in Kuwait, we have different generations practicing most of the time together. ... These doctors or some doctors are from the old school, which takes a longer time, and it's difficult to change their beliefs.”

(P8, senior registrar)

The evolution of SAP timing was cited as a specific example of shifting practice. While guidelines have moved from administering antibiotics post-surgery to before skin incision, some doctors remain tied to older practice:

“Before, it was to be given only after surgeries, and this practice was from 15 years ago. Then, after that era, they give it while skin incision. And then the new guidelines are before skin incision.”

(P9, senior registrar)

Despite updates in guidelines, the reluctance to change traditional practice persists. One participant expressed scepticism about the level of adherence to updated policies, highlighting the continuing impact of older practice:

“But still, I’m 100% sure that if you check the patient files, most of them are still receiving post-op antibiotics. So this is related to the old practice, and these doctors are just not fully comfortable or not fully aware that there is a policy.”

(P8, senior registrar)

4.3.5.2.5. Multidisciplinary team (Barrier and facilitator)

The involvement of multidisciplinary teams (MDTs) in SAP prescribing was identified as essential but often an underutilised component of effective patient care. Participants highlighted challenges and opportunities for collaboration across different specialities, including surgeons, anaesthetists, clinical pharmacists, and microbiologists. Some participants noted the minimal involvement of the anaesthetic team in SAP prescribing decisions despite their role in administering antibiotics during surgery. One senior registrar remarked:

*“The anaesthesia team is usually not involved in antibiotics prescribing.”
(P9, senior registrar)*

However, others emphasised that anaesthetists could play a role in antibiotic decisions in collaboration with surgeons:

*“Anaesthetists also prescribe it because it's the anaesthetists who give them during the OT, so even they are involved in which kind of antibiotics should be given to them..... It should be the anaesthetists as well as the consultant together in collaboration.”
(P1, registrar)*

A consultant highlighted the shared responsibility between surgeons and anaesthetists, emphasising the importance of teamwork and adherence to guidelines:

“For my opinion, actually this is the responsibility of the anaesthetic. OK. However, obstetricians should always try to emphasise that the antibiotic is given. This is written in our books and written also in their

books. It's our job because it's written in our guidelines. It's written in our guidelines when to give antibiotics, what type of antibiotics that should be given in what operations in detail, this is our responsibility. So from our point of view, we are responsible for this, but also in cooperation with them and anaesthetics"

(P10, Consultant)

Moreover, effective communication between departments emerged as a recurring issue, with participants describing poor coordination between teams.

For example, a registrar shared:

"I think as I said, like uh, it's just that every team runs separately, and we each team has, like their own agenda to follow. ... It's very difficult to integrate between each other unless, for example, the patient is in the ICU where everyone there is involved. It's different, but in the wards or in the labour room, it's more fast-paced. So it makes communication between the different teams difficult."

(P11, registrar)

Additionally, the lack of official communication platforms, such as hospital email systems, was highlighted as a barrier. When participants were asked about the availability of an official mode for staff communications, one participant said:

"This is true. The mode of communication. One example is that we don't have emails. We are using our personal emails. Then you send the e-mail, sometimes it isn't junk. ... If I have an official work e-mail, I will feel more responsible to look through it."

(P8, senior registrar)

On the other hand, the involvement of clinical pharmacists in SAP prescribing was another area of concern. While some participants valued their expertise, they noted that pharmacists were often excluded from surgical settings:

“Unfortunately, we don’t have a clinical pharmacist in the OT. Like when I was doing my rotations with the medical team, we would have a clinical pharmacist around, and we would take their opinions, and we trust them.”

(P4, assistant registrar)

The same participant suggested that clinical pharmacists should be integrated into surgical teams to provide guidance on antibiotics:

“I think, as I said before, the clinical pharmacist should be involved as well in the surgical field, not only the medical field.”

(P4, assistant registrar)

Furthermore, participants emphasised the importance of involving all specialities in decision-making to ensure safe and effective SAP prescribing practices. One senior registrar explained the value of seeking input from multiple teams:

“We have to take all the opinions from all the departments. We are surgeons, and we need to prescribe medication, so we need the pharmacist’s opinion. We have blood culture results. We need microbiology. ... I have never talked to any pharmacist before regarding medication.”

(P8, senior registrar)

Some participants suggested involving MDT, including pharmacists, nurses, and microbiologists, to ensure proper dissemination and effective implementation of guidelines through regular meetings and discussions to create awareness and adherence among all stakeholders to improve practice and prescribing safety.

“We actually have local guidelines. ... Maybe, like, conduct a meeting with the doctors and just kind of go through the guidelines together or, like, in each department to have all the MDT [multidisciplinary team], like the nurses, the doctors, the pharmacy store, the microbiologist, and have a discussion to talk about it. Just to be aware.”

(P11, registrar)

To address communication gaps, participants proposed solutions such as inter-departmental policies and communication tools such as a direct WhatsApp line. A consultant suggested:

“We can do inter-departmental policies between us and radiology, surgery, and some related specialties. We can do this link through WhatsApp ... Just to give questions and answers. This will be more helpful if it is easy access.”

(P13, consultant)

Some participants also called for better integration and regular meetings between teams:

“At the hospital level, I think having meetings with heads of departments and each department would have a census or reports or audits ... having that regularly, then we would always pick up on the wrong and hopefully improve it.”

(P11, registrar)

Several social factors were identified as influencing SAP prescribing in Kuwait, including patient expectations, hygiene, and specific patient risk factors. In addition, senior influence, a lack of audit system, and inadequate interdepartmental communication and collaboration also contributed to the inappropriate prescribing of SAP.

4.3.6. Summary of the facilitators and barriers and the Behavioural Change Wheel intervention functions to improve SAP prescribing in Kuwait.

The barriers and facilitators mentioned by the participants have been mapped to the COM-B model and linked to the relevant intervention function and policy according to the BCW (Table 4.2) and the overall summary table of the intervention function (Table 4.3).

Table 4.4:2: Summary of the facilitators and barriers mapped to the intervention functions and policies

COM-B	Barriers	Facilitators	BCW intervention functions/	Policies
Physical Capability	• Inconsistent documentation • Reliance on handwritten or verbal orders • Self-established protocols • Limited regular training and awareness • Knowledge gaps between senior and junior staff	• Introduce electronic prescribing reminders • Standardised documentation templates. • Regular guidelines and documentation training • Awareness campaigns, lectures, and induction sessions for newcomers	• Training • Enablement • Environmental Restructuring	• Guidelines • service provision • Environmental/social planning
Psychological Capability	• Limited knowledge of guideline content, timing, duration, and selection • Overreliance on personal experience • Misconception that longer or broader SAP prevents infection	• Continuous education and refresher courses • Clear and accessible local/national guidelines • Decision-support tools and visual reminders • Promote practice standardisation	• Education • Training • Persuasion • Enablement:	• Guidelines • Communication/marketing • Service provision

Physical Opportunity	- Occasional drug shortages (e.g., COVID-19) - Absence of unified national guideline - Profit-driven prescribing in private sector - Limited access to printed/e-guidelines	- Ensuring resource availability - Standardised national guidelines across sectors - Provide digital guidelines and disseminate hard copies guidelines in wards - Improve national supply chain during crisis	- Environmental restructuring - Persuasion - Training - Education - Regulation	- Guidelines - Fiscal measure - Service provision
Social Opportunity	- Senior doctors' influence overriding guidelines - Patient demands and cultural expectations - Misconception of allergy - poor patient involvement in decision-making - Lack of audit and feedback - Limited interdepartmental collaboration	- Multidisciplinary team collaboration (Pharmacist, nurse, microbiologist, infection control) through regular meeting and shared protocols - Regular audits and feedback - Patient education on hygiene and wound care - Cultural awareness sessions and public campaigns	- Modelling - Incentivisation - Education - Persuasion - Enablement	- Guidelines - Service provision - Communication/marketing - Regulation

Reflective Motivation	• Beliefs in broad-spectrum superiority • Defensive prescribing to avoid blame and litigation • Variable practice across sectors • Guidelines viewed as optional	• Shifts toward evidence-based practices through updated knowledge • Acknowledgment of effective narrow-spectrum SAP and AMR trends and risks • Positive reinforcement and role-modelling • Promote evidence-based prescribing	• Persuasion • Education • Modelling • Incentivisation	• Guidelines • Communication/marketing • Regulation
Automatic Motivation	• Lack of penalties for guideline non-compliance • Punitive culture discourage engagement with protocols • Absence of structured appraisals for compliance	• Introduce non-punitive feedback and appraisal systems • Recognition and incentives for compliance • Constructive feedback systems	• Incentivisation • Feedback • Enablement • Feedback	• Regulation • Service provision • Guidelines • Communication/marketing

Following identification of key behavioural determinants affecting SAP prescribing, the findings were mapped onto the COM-B model and linked to relevant BCW intervention functions (Table 4.2).

Under physical capability, barriers included inconsistent SAP documentation and continued reliance on verbal or handwritten prescriptions. Appropriate interventions included environmental restructuring, such as introducing electronic prescribing systems, and training through structured documentation workshops.

For psychological capability, limited knowledge and variable decision-making were prominent barriers. These can be addressed through education (targeted lectures and workshops) and enablement, ensuring clinicians have access to clear, standardised national guidelines.

In the physical opportunity domain, constraints such as drug shortages and the absence of unified national guidelines were highlighted. Suggested strategies included environmental restructuring to strengthen supply chains and restriction of non-evidence-based practices through national policy enforcement.

The social opportunity barriers included peer influence and patient demands that conflicted with evidence-based practice. Facilitators included promoting

multidisciplinary collaboration and strengthening audit and feedback mechanisms, supported by modelling and incentivisation strategies.

Within reflective motivation, defensive prescribing driven by fear of blame and misconceptions about broad-spectrum efficacy were identified as key barriers. These could be mitigated through persuasion (e.g., data feedback or educational reports) and incentivisation strategies, such as recognition for guideline adherence.

Finally, automatic motivation was shaped by the absence of formal accountability systems. Participants recommended introducing incentive and feedback mechanisms, including recognition, structured appraisal, and non-punitive performance monitoring, to foster a supportive culture that reinforces positive prescribing behaviour.

Table 4.4:3: Summarised Recommended Intervention Functions Mapped to COM-B Components

Intervention function									
	Education	Persuasion	Incentivisation	Coercion	Training	Restriction	Environmental restructuring	Modelling	Enablement
Physical capability									
Psychological capability									
Physical opportunity									
Social opportunity									
Automatic motivation									
Reflective motivation									

4.4. Discussion

4.4.1. Key Findings

This study aimed to explore the behavioural and structural barriers and facilitators influencing SAP prescribing as well as guideline adherence in OB/GYN surgery in Kuwait. Using the COM-B model framework, barriers and facilitators affecting SAP prescribing were identified. Thereafter, these barriers and facilitators were then mapped to the BCW to identify potential interventions. Each component of the COM-B model was linked to a barrier or facilitator through semi-structured interviews with 13 OB/GYN doctors of varying experience levels.

Under capability, key issues were identified in physical and psychological factors, such as inconsistent documentation, reliance on personal experience rather than guidelines, and knowledge gaps. Under the opportunity domain, physical and social factors played a critical role in influencing prescribing practice through occasional medication shortages, profit-driven prescribing in the private sector, absence of clear national guidelines, patient expectations, lack of MDT collaboration and influence of senior colleagues. Finally, under motivation, the reflective and automatic subdomains highlighted issues that impacted prescribing practice through defensive approaches to prescribing, driven by the fear of blame or litigation, which further led to a preference for broad-spectrum antibiotics. Furthermore, the lack of incentive and the predominant punitive culture significantly affected the appropriate prescribing of SAP.

This study showed that SAP prescribing was influenced by a complex network of factors across all COM-B domains. Rather than acting independently, these influences were deeply interconnected, with gaps in one domain often strengthening barriers in another. This section explores the interconnected nature of these behavioural determinants and emphasises how tackling them in a coordinated way can promote more appropriate and consistent SAP prescribing.

4.4.2. Comparison with the literature

The findings of this study emphasise how gaps in knowledge about appropriate timing, duration, and indication for SAP may challenge prescriber's capability to make guideline-compliant decisions. Although participants generally understood the overall purpose of SAP in preventing SSI, they showed varying understanding of key prescribing parameters. For example, while some participants correctly recognised that SAP should be administered before skin incision (American College of Obstetricians and Gynecologists, 2018), others believed that it should be given during the surgery. Several factors may contribute to this confusion, including the high volume of emergency surgery, particularly C-sections, where time pressure and workflow interruptions may impact proper timing, as well as perceived concerns about the potential antibiotic exposure to neonates when SAP is administered before cord clamping (Bossung *et al.*, 2022). However, randomised controlled studies such as Dierikx *et al.* (2022), found that SAP timing (before versus after cord

clamping) did not significantly alter the neonatal gut microbiome or lead to adverse effects. This supports the current recommendations to administer SAP before skin incision for optimal SSI prevention.

Nevertheless, the appropriate timing of SAP has been well-documented in previous studies, showing that SAP administration within one hour before surgery significantly reduces the risk of SSI compared to earlier or later administration (Steinberg *et al.*, 2009; de Jonge *et al.*, 2017a; Sommerstein *et al.*, 2023). This recommendation is endorsed by international guidelines, including those from NICE and ACOG, which advise administering antibiotics within 60 minutes before skin incision (American College of Obstetricians and Gynecologists, 2018; National Institute for Health and Care Excellence (NICE), 2019). However, a cohort of 55,901 C-sections across 75 Swiss hospitals showed that delaying SAP administration after cord clamping in C-section does not increase the risk of SSI post-operation to the mother and may help prevent antibiotic-associated side effects in the neonate (Sommerstein *et al.*, 2020). Additionally, miscommunication between clinicians and nursing staff, or a lack of knowledge or insufficient training among junior clinicians, may further contribute to poor adherence (Hassan *et al.*, 2021). These knowledge gaps seem closely connected to deficiencies in formal training. Many participants, especially junior clinicians, reported that training on antibiotic prescribing was not sufficiently covered in undergraduate education or during early clinical training. Moreover, some participants noted that such training opportunities were rarely available either during induction or as part of continuing

professional development (CPD). Notably, many participants recognised the lack of knowledge and expressed a desire for training specifically on appropriate SAP prescribing and guideline adherence.

These findings align with broader trends reported in the antimicrobial stewardship literature (Wong *et al.*, 2021; Saleem *et al.*, 2025), where clinicians often receive limited formal training on antimicrobial prescribing, instead relying on informal learning or practical experience. For example, a study of infectious disease fellows reported that most antimicrobial stewardship education occurs through on-the-job experience rather than during structured courses or rotations (Wasson *et al.*, 2023). The WHO practical guide of antimicrobial stewardship intervention emphasised that both clinical training and structured education are fundamental components of healthcare professional development, with practical experience and CPD playing key roles (World Health Organization, 2021a). A recent systematic review further demonstrated that while structured educational interventions can produce short-term improvements in prescribing knowledge and attitudes, these effects are often unsustainable unless reinforced by real-world application and ongoing professional development (Langdridge *et al.*, 2024). Therefore, it is crucial to ensure that healthcare professionals are not only knowledgeable but also highly skilled and capable of delivering exceptional patient care through practical experience and ongoing learning.

Due to these limitations, many junior clinicians tend to depend heavily on experiential learning and senior role modelling to guide their prescribing decisions. While learning from senior colleagues is vital in medical training, this approach may spread practice that is inconsistent with evidence-based guidelines. These findings align with the current study, where several participants reported that prescribing behaviour was largely influenced by senior doctors' experience rather than guidelines, leading to variability in SAP prescribing. Similar studies have shown that junior clinicians often adopt prescribing habits from senior clinicians, even when these deviate from established guidelines (Charani *et al.*, 2013; Charani *et al.*, 2017; Ierano *et al.*, 2019b; Alemkere *et al.*, 2023). While in certain complex cases not fully covered by guidelines, the senior clinician's experience may provide an appropriate SAP prescribing tailored to the case. Charani *et al.* (2013) observed that seniors frequently consider themselves exempt from guidelines and rely on personal judgment, a behaviour that could lead to perpetuating inconsistent practices. When such decisions are left unchallenged or undocumented, they may result in variability and inconsistency in care, a pattern that was also evident among participants in Kuwait. As participants similarly described a clinical culture where senior clinician's preferences shape SAP prescribing, often guided more by personal experience than by guideline adherence. In addition, senior doctors were reported to promote individualised protocols. This reflects a broader pattern in surgical specialities, where clinical autonomy and seniority frequently override institutional protocols and evidence-based standards (Charani *et al.*, 2013; Charani *et al.*, 2017; Ierano *et al.*, 2019b).

The dominant hierarchical and punitive culture also shapes SAP decision-making in this study, particularly by discouraging junior doctors from challenging senior-led practice even when that practice deviates from guidelines. Consistent with previous research showing that junior doctors frequently comply with the orders and prescribing habits of their seniors, a behaviour largely driven by a fear of criticism and avoiding confronting long-standing hierarchical routines to prevent “upsetting” their superiors (Papoutsi *et al.*, 2017). Participants in this study described similar cases where senior influences and fear of blame limited independent clinical decisions. This could reinforce how hierarchical norms within the Kuwait hospitals contribute to defensive and experience-prescribing over evidence-based prescribing.

Additionally, concerns about potential blame or litigation following adverse outcomes led many clinicians to adopt a defensive prescribing approach, often resulting in overtreatment. A recent systematic review reported that such defensive practices can cause overdiagnosis, overtreatment, and poorer quality care (Lorenc *et al.*, 2024). Similarly, an analysis of U.S. malpractice trends showed that doctors were less likely to prescribe antibiotics when malpractice pressure decreased, indicating that liability risk influences excessive antibiotic use (Panthöfer, 2022). This tendency was especially pronounced in obstetric surgery, where clinicians expressed increased concern for both maternal and neonatal outcomes, often favouring overtreatment as a protective measure (Zwecker *et al.*, 2011).

This study found that some clinicians, particularly in the private sector, prescribed antibiotics “just in case” to minimise perceived risks and maintain patient satisfaction. However, such precautionary prescribing increases the risk of antibiotic-related adverse effects and contributes to the broader problem of AMR (Goff *et al.*, 2018). Similar defensive prescribing behaviours have been documented in other high-risk surgical fields, where fear of post-operative complications and potential litigation motivates clinicians to adopt overly cautious antimicrobial strategies (Hassan *et al.*, 2021). These pressures, particularly in the private sector, may drive decisions that prioritise perceived safety and satisfaction over strict adherence to clinical guidelines (Ierano *et al.*, 2019b). These findings highlight how medical, legal and patient pressure (especially in the private sector) can affect SAP decision-making.

Another key finding was the persistent belief among some clinicians that broad-spectrum antibiotics, such as third-generation cephalosporins, offer superior protection against postoperative infection. These perceptions align with international research showing that beliefs in the superior efficacy of broad-spectrum agents often override established guideline recommendations (Charani *et al.*, 2017; Hassan *et al.*, 2021; Alemkere *et al.*, 2023). However, evidence indicates no additional benefit of broad-spectrum agents over narrow-spectrum antibiotics, such as cefazolin, in preventing SSIs, and their use is more frequently associated with adverse effects and increased AMR (Cooch *et al.*, 2023). This belief persisted despite widespread awareness of

increasing AMR and existing guideline recommendations that favour narrow-spectrum agents, such as cefazolin (American College of Obstetricians and Gynecologists, 2018; National Institute for Health and Care Excellence (NICE), 2019). Participants often justified the use of broader-spectrum agents based on uncertainty about potential pathogens or a perceived need to avoid complications. This is consistent with literature indicating that clinical uncertainty often leads to increased prescribing, particularly of broad-spectrum antibiotics (Liu *et al.*, 2021).

Structural and contextual factors identified in this study also influenced SAP prescribing. Although drug shortages were reported as infrequent, they impacted SAP prescribing, especially during the COVID-19 pandemic. In some cases, such shortages required the substitution of recommended first-line agents with broad-spectrum alternatives, which is in line with previous studies indicating COVID-19 shortages of essential first-line antibiotics often led to increased use of alternative broad-spectrum antibiotics (Shafiq *et al.*, 2021; Pandey *et al.*, 2025). While cost considerations were not reported as a barrier in public hospitals, participants from the private sector highlighted that profit motives and the preference for expensive antibiotic brands sometimes influenced prescribing decisions. This finding is consistent with Guo *et al.* (2021), who reported similar financial incentives driving antibiotic selection, and with Lim *et al.* (2024), who observed greater use of “Watch” and “Reserve” agents in private healthcare. Together, these findings suggest that structural factors such as drug availability, profit and sectoral differences can shape

decision-making in Kuwait, leading to unnecessary deviation from clinical guidelines.

Social and cultural norms also shaped prescribing behaviour. Participants cited hygiene-related misconceptions and traditional postpartum practice, such as avoiding bathing for extended periods, as perceived risk factors for SSIs. However, this contrasts with established clinical guidelines, which recommend bathing post-surgery to support hygiene and recovery (American College of Obstetricians and Gynecologists, 2018; National Institute for Health and Care Excellence (NICE), 2019). In response, clinicians often prescribed antibiotics prophylactically in cases they viewed as low risk but potentially vulnerable due to poor hygiene or compliance. This underscores the importance of understanding patient context and cultural environment when making prescribing decisions. Notably, a Thai cohort study involving 909 postpartum women found no significant difference in hygiene practice between those who developed infections and those who did not (Sirilak *et al.*, 2022), highlighting the need to re-evaluate hygiene-based antibiotic prescribing in light of cultural assumptions and empirical evidence.

Inconsistent SAP documentation and reliance on verbal communication were major challenges identified in this study. Participants described routine dependence on nursing staff to execute orders, often without proper written documentation. Similar to previous findings, it was shown that poor documentation of pre- and post-operative orders was common, potentially

causing communication issues, and possibly leading to SAP being continued for longer than necessary (Ierano *et al.*, 2019b; Hassan *et al.*, 2021; Alemkere *et al.*, 2023). Handwritten prescribing was regarded as one of the barriers that could contribute to poor SAP documentation due to the increased risk of errors, forgetfulness, and inconsistency. A previous study has shown that handwritten prescriptions were associated with poor patient outcomes, a higher risk of errors, and inadequate documentation compared to electronic prescribing (Albarrak *et al.*, 2014).

The lack of structured documentation also pointed to systemic barriers rather than individual limitations. There was a desire among clinicians for improved documentation and standardisation of documentation, including detailed documentation of indications, selection, timing, and duration for both pre- and post-operation orders. Some participants suggested that introducing electronic prescribing systems with built-in alerts, as recommended by the WHO and CDC, could help standardise SAP (Centers for Disease Control and Prevention, 2019; World Health Organization, 2021a). Such systems can also reduce reliance on verbal orders, improve communications, and provide a more robust audit trail. Similarly, previous studies have advocated for the use of electronic systems with alert systems to enhance SAP prescribing, improve patient safety, strengthen antimicrobial stewardship, and increase prescriber accountability (Ierano *et al.*, 2019b; Jenkins *et al.*, 2022).

Inconsistent access to SAP guidelines emerged as a major barrier to appropriate prescribing in this study. While some clinicians reported easy access to digital versions of local protocols, others, particularly junior doctors, struggled to locate hard copies or were unaware of their existence. The poor dissemination and clarity of protocols not only hinder adherence but also encourage the spread of informal and inconsistent practice (Shehu *et al.*, 2025). As outlined in the literature, ease of access, visibility, and clarity of guidelines are critical factors in ensuring guideline compliance (Charani *et al.*, 2017; Ierano *et al.*, 2019b; Alemkere *et al.*, 2023; Turner *et al.*, 2023; Shehu *et al.*, 2025). Additionally, the lack of a unified national SAP guideline was a source of frustration among many participants. Clinicians highlighted that each hospital, particularly in the private sector, appeared to operate under distinct protocols. This fragmentation, coupled with the diversity of clinicians' training backgrounds in Kuwait, led to confusion and variability in SAP practice. Participants also noted that many existing guidelines were outdated and in need of revision. The call for a single, regularly updated unified national SAP guideline applicable to both public and private hospitals was consistently demanded.

Limited MDT collaboration also influenced SAP decision-making in this study. Despite recognising the importance of MDT input, participants reported limited collaboration with key stakeholders, such as clinical pharmacists, microbiologists, and anaesthetists. This lack of interactions can leave prescribing decisions to individual clinicians, limiting opportunities for review

and feedback. As recommended and highlighted by the WHO, all antimicrobial stewardship must rely on a collaborative MDT approach, involving clinicians, pharmacists, microbiologists and infection control professionals (World Health Organization, 2021a). Strengthening these collaborations could enhance the consistency in prescribing decisions and support shared responsibility for SAP decisions.

However, most participants reported that SAP prescribing decisions were made unilaterally by surgeons without consultation with other departments. This lack of communication and collaboration may weaken stewardship efforts and reduce the consistency of practice across departments. This aligns with previous findings, which reported a similar lack of MDT engagement in surgical settings (Charani *et al.*, 2017). However, several participants proposed practical solutions for more structured interdepartmental communication, such as holding routine MDT meetings, involving pharmacists in surgical teams, and utilising digital tools to facilitate interdisciplinary communication. These suggestions echo the wider evidence base, which demonstrates that structured MDT approaches can reduce medication errors, optimise antibiotic use, and improve perioperative patient outcomes (Ierano *et al.*, 2019b; Hassan *et al.*, 2021; Alemkere *et al.*, 2023). The lack of an audit and feedback cycle was a recurrent concern. Without regular monitoring, inappropriate prescribing practice often went unnoticed and unaddressed. Participants highlighted the need for continuous evaluation, periodic audit, and structured feedback to support learning and performance improvement. The WHO emphasised that

audit and feedback are one of the core components of antimicrobial stewardship interventions (World Health Organization, 2021a). In addition, prior studies have demonstrated that audit and feedback interventions can significantly enhance antimicrobial prescribing appropriateness, particularly when delivered with peer benchmarking or educational reinforcement (Ierano *et al.*, 2019b; Alemkere *et al.*, 2023; Turner *et al.*, 2023).

4.4.3. Clinical implications

The findings of this study reveal several key clinical implications for improving SAP prescribing in OB/GYN settings. Targeted education and continuous professional development are essential, particularly for junior clinicians, with a focus not only on general antimicrobial principles but also on critical parameters such as timing, duration, and antibiotic selection, areas often misunderstood in practice. Inconsistent documentation and reliance on verbal orders were also identified as contributors to inappropriate prescribing. Implementing electronic prescribing systems with built-in alerts and auto-discontinuation prompts could standardise practice, reduce errors, and strengthen communication between surgical and nursing teams.

Equally, the lack of accessible, unified SAP guidelines and the fragmentation of local protocols highlight the need for a national, regularly updated guideline embedded in clinical workflows. Strengthening multidisciplinary team involvement, especially clinical pharmacists and microbiologists, through structured meetings or digital platforms, may further support guideline

adherence. Finally, the absence of routine audit and feedback systems represents a missed opportunity for antimicrobial stewardship; integrating non-punitive, data-driven feedback into surgical care pathways could drive quality improvement, foster accountability, and reinforce evidence-based prescribing practices across institutions.

4.4.4. Strengths and limitations

4.4.4.1. Strengths

One of the key strengths of this study is that it is the first qualitative research investigating barriers and facilitators to the appropriate prescribing of SAP in the OB/GYN field in Kuwait, guided by the COM-B model and BCW. This framework provided a structured analytical lens through which barriers and facilitators to appropriate SAP prescribing could be systematically identified and contextualised. By embedding the analysis in a behaviour change framework, the study offers not only descriptive insights but also actionable implications for designing targeted antimicrobial stewardship interventions.

Another strength lies in the diversity of the participant sample. Interviews were conducted with OB/GYN clinicians across both public and private hospitals and included professionals at varying levels of seniority, consultants, senior registrars, and assistant registrars, enabling a richer understanding of SAP decision-making hierarchies and contextual influences across different institutions. The use of semi-structured interviews further contributed to the collection of rich, contextualised data across a range of practice environments.

Data saturation was achieved when no new codes or themes emerged from the interviews, ensuring the comprehensiveness of the findings.

Lastly, the study is both timely and relevant, offering urgently needed insight into SAP prescribing practice in maternity care in Kuwait, a setting where concerns about AMR and inappropriate antibiotic use are particularly pressing. This study directly aligns with the objectives of the Kuwait National Action Plan on antimicrobial resistance, which emphasises optimising SAP use through stewardship surveillance and behavioural change among clinicians.

4.4.4.2. Limitations

Despite the study's strengths, several limitations must be acknowledged. Interviews were conducted in English, which may have hindered some participants' ability to express themselves fully, particularly for those whose first language is Arabic. However, this limitation was mitigated by allowing participants to use Arabic words or phrases when needed, which were subsequently translated into English to preserve the original meaning and context.

Data collection occurred during a period when hospitals were still adapting to COVID-19-related disruptions, which may have temporarily influenced prescribing behaviour, documentation quality, and workflow patterns. Some of the barriers identified may therefore reflect short-term situational factors rather

than systemic issues. However, findings were interpreted with this context in mind, and comparisons were made with the literature to distinguish patterns.

Finally, while the study captured diverse perspectives from OB/GYN doctors across public and private hospitals, it did not include input from other key stakeholders such as hospital administrators, infection control personnel, or Ministry of Health representatives. This limited the ability to explore governance, enforcement, and policy-level influences on SAP practice. However, this limitation was partly addressed through triangulation with findings from the PPS and KAP studies (Chapters 2 and 3), which provided complementary system-level insights into guideline dissemination and compliance.

4.4.5. Conclusion

This study sheds light on the behavioural drivers of SAP prescribing in OB/GYN surgery in Kuwait, revealing how knowledge gaps, hierarchical influence, documentation issues, defensive practice, and weak institutional structures contribute to inappropriate use of antibiotics. These behaviours are often underpinned by system-level shortcomings, including inconsistent guideline access, lack of training, poor multidisciplinary communication, and absence of accountability structures. Despite these challenges, clinicians showed a willingness to improve, with many expressing support for clearer guidelines, more training, and constructive feedback. The COM-B analysis revealed that targeted interventions, such as training, enablement,

incentivisation, and environmental restructuring, could substantially improve SAP adherence if implemented through national AMS policies. By addressing the barriers identified and building on existing facilitators, Kuwait has an opportunity to implement a behaviourally informed and locally tailored antimicrobial stewardship strategy. Doing so will not only optimise antibiotic use in surgical care but also contribute to broader national and global efforts to combat antimicrobial resistance.

Chapter 5. General Discussion and Conclusion

This chapter synthesises and integrates the results from the three previous PhD studies and compares them with the wider literature. It triangulates the main findings from both quantitative and qualitative results to clarify what is happening, why it is happening, and what should change, linking these insights to antimicrobial stewardship interventions and policy. Recommendations for policy, clinical practice and future research are proposed. The strengths and limitations of the research are discussed. The chapter concludes with a summary drawn from the studies conducted.

5.1. Introduction:

This PhD research explored and evaluated the prescribing of SAP in OB/GYN surgery in Kuwait, employing a sequential explanatory mixed-methods design (Creswell *et al.*, 2017), with the overarching aim of improving the quality of SAP prescribing by recommending tailored antimicrobial stewardship interventions.

The first study (Chapter 2) was conducted to explore and evaluate the prescribing of SAP in OB/GYN surgery at the national level across both private and public hospitals, using a PPS (quantitative) adapted from the global point prevalence survey protocol and WHO methodology for PPS (World Health Organization, 2018b; University of Antwerp, 2021). The PPS revealed widespread use of SAP across OB/GYN procedures; however, this high utilisation did not reflect appropriate practice. SAP was frequently used even when it was not eligible, and even when it was eligible, it was commonly

administered with inappropriate timing, excessive duration, and unnecessary broad-spectrum selection. As a quantitative snapshot, the PPS indicated a systemic problem but did not explain its behavioural drivers.

The second study (Chapter 3) built on the findings of the first study to evaluate knowledge, patterns in attitude, and practice regarding the appropriate use of SAP and adherence to guidelines, using a self-administered questionnaire (quantitative) targeting clinicians responsible for SAP prescribing. The survey (n=123) revealed low overall knowledge, particularly regarding SAP antibiotic selection, timing windows, and post-operative indication, alongside generally neutral attitudes and basic self-reported practice (representing partial adherence to SAP guidelines, Chapter 3). Taken together, these results provided key insights into behavioural factors underlying the PPS findings, showing that inappropriate SAP prescribing was linked not only to system-level variation but also to gaps in clinician knowledge, uncertainty in decision-making, and inconsistent attitudes towards guideline adherence. However, the KAP study could not fully explain the contextual, organisational, and cultural influences shaping clinicians' behaviour, emphasising the need for qualitative exploration to understand why these prescribing patterns persisted.

A final qualitative study (Chapter 4) using in-depth semi-structured interviews was then designed to build on the PPS and KAP findings and provide a deeper understanding of the behavioural and contextual factors influencing SAP prescribing. The results of the first two studies informed the development of

the topic guide for the semi-structured interviews. Thirteen OB/GYN specialists were interviewed to identify barriers and facilitators to the appropriate use of SAP. The study identified 16 subthemes across the behavioural COM-B (capability, opportunity, motivation, behaviour) framework, including individual (Michie *et al.*, 2011; Atkins *et al.*, 2017), social, and system-level barriers and facilitators that influence the appropriate prescribing of SAP in Kuwait.

These three studies provided a comprehensive behavioural description and explanation of suboptimal SAP prescribing in Kuwaiti OB/GYN surgery and establish a foundation for designing and developing targeted stewardship interventions.

5.2. Integrated summary of the key findings

The integration of findings across the three studies presented a complex, multifaceted picture of SAP prescribing in OB/GYN surgery in Kuwait. The PPS (Chapter 2) highlighted several sub-optimal practices in SAP prescribing. Overall adherence to local SAP guidelines and appropriateness, based on ACOG standards (American College of Obstetricians and Gynecologists, 2018), was suboptimal, either due to SAP misuse, like incorrect antibiotic selection, timing, or indication, and overuse, such as prolonged postoperative continuation of prophylaxis.

Almost all SAP-ineligible procedures (clean surgery) received prophylaxis, while many indicated cases (clean-contaminated surgery) received additional unnecessary doses. These findings align with global surveillance data,

including the European Surveillance of Antimicrobial Consumption (ESAC), WHO Global Antimicrobial Resistance and Use Surveillance System (GLASS) and the European Centre for Disease Prevention and Control (ECDC), that highlight inappropriate overuse of SAP worldwide (Al-Taani *et al.*, 2018; Plachouras *et al.*, 2018; *Global Antimicrobial Resistance and Use Surveillance System (GLASS) Report*, 2021). This was consistent with regional studies in the UAE, Saudi Arabia and Egypt (Alshehhi *et al.*, 2021; Haseeb *et al.*, 2021; M. Magdy *et al.*, 2021; Vipadapu *et al.*, 2022). This key finding could be explained by the findings from the KAP survey (Chapter 3), which revealed a lack of knowledge regarding the classification of surgical procedures and procedures that require SAP, as well as by the findings from the interviews (Chapter 4) which showed that this lack of knowledge subsequently translated into the belief that “*all surgeries require SAP.*” Misclassification of surgical procedures has been described in international literature, particularly in abdominal procedures such as hysterectomy (Stefanou *et al.*, 2020), with contributing factors including insufficient training, inconsistent documentation, and variable decision-making (Levy *et al.*, 2015; Fullington *et al.*, 2023). These findings suggest that the inappropriate initiation of SAP is influenced by both knowledge gaps and wider systemic and cultural factors.

Antibiotic selection also reflected these interlinked drivers. The PPS (Chapter 2) highlighted persistent deviation from SAP guideline practice, which recommended the use of narrow-spectrum first-generation cephalosporin (American College of Obstetricians and Gynecologists, 2018). The PPS

showed that broad-spectrum antibiotics from the WHO Watch group, particularly third-generation cephalosporins, predominated in pre- and intra-operative prescribing, while escalation with combination regimens (including anaerobic coverage) was common post-operatively. These findings mirror global PPS data showing disproportionate reliance on broad-spectrum prophylaxis (Gouvea *et al.*, 2015; Khan *et al.*, 2020a; Klein *et al.*, 2021; Pauwels *et al.*, 2021a; Romero Viamonte *et al.*, 2021; Schrama *et al.*, 2025). These PPS findings could be explained by the KAP survey (Chapter 3), which confirmed that low preference for narrow-spectrum antibiotics was primarily driven by gaps in knowledge regarding recommended SAP agents, alongside neutral attitudes towards guideline adherence. The qualitative interviews (Chapter 4) further indicated that clinicians perceived broad-spectrum agents as “safer”. Metronidazole was often suggested post-operatively, despite guidelines restricting its use to specific procedures such as hysterectomy (American College of Obstetricians and Gynecologists, 2018; National Institute for Health and Care Excellence (NICE), 2019). Similar patterns were reported in Tanzania, which found frequent use of metronidazole, despite limited indications (Schrama *et al.*, 2025). In this study, qualitative interviews (Chapter 4) indicated that clinicians perceived abdominal and pelvic surgery to carry higher risk of anaerobic contamination, leading them to add metronidazole as “extra coverage”. Participants also reported uncertainty about which procedures truly require anaerobic cover, often relying on habitual practice or departmental norms rather than guidelines. Collectively, these insights suggest that inappropriate post-operative use of metronidazole is driven by

misconceptions about contamination risk and persistent prescribing norms that override evidence-based recommendations.

Inappropriate duration of SAP further emphasises knowledge gaps and cultural norms. The PPS (Chapter 2) demonstrated that SAP was extended in most patients, exceeding the recommendation for single-dose prophylaxis (American College of Obstetricians and Gynecologists, 2018; National Institute for Health and Care Excellence (NICE), 2019). This finding is consistent with global evidence showing that duration is the most problematic SAP parameter, with 60–90% of patients in Asia, Africa, and parts of Europe receiving extended courses of therapy (Argaw *et al.*, 2017; Della Polla *et al.*, 2020; Khan *et al.*, 2020c; Schrama *et al.*, 2025). This PPS finding was further explained by the KAP survey (Chapter 3), which showed that fewer than half of participants recognised single-dose SAP as an appropriate duration, while some believed that SAP duration is dependent on the patient's level of hygiene. The interview data (Chapter 3) highlighted these behaviours, with participants offering some explanations for SAP duration drivers. These included routine practice often mandated by senior colleagues, the belief that continuing antibiotics throughout the hospital stay reduces the risk of infection, and patients' limited awareness of self-hygiene and post-operative wound care, all of which align with previous literature (Hassan *et al.*, 2021). This is despite the fact that much of the previous literature shows that extending SAP duration does not lower SSI, but rather it is associated with increased AMR and side effects such as acute kidney injury (Branch-Elliman *et al.*, 2019). Prolonging prophylaxis thus

indicates not only knowledge gaps but also defensive prescribing (Ortashi *et al.*, 2013; Lorenc *et al.*, 2024), where clinicians aim to reduce personal accountability for SSI.

Poor documentation of pre- and post-operative and prescriber roles compounded these behaviours. The PPS showed that justification for prolonged SAP was never recorded, and pre-operative antibiotic orders were documented in just over half of patients, although stop/dates were more consistently documented for post-operative SAP. These findings conflicted with the KAP study (Chapter 3), which suggested higher self-reported compliance with documentation, highlighting a perception–practice gap. Interviewees acknowledged that documentation was often incomplete or absent, and there was a reliance on verbal orders, particularly in public hospitals, which introduced risks of omission, miscommunication, and increased nursing workload. These findings align with previous studies that have reported poor documentation of SAP, especially regarding duration and justification (Alemkere *et al.*, 2023; Schrama *et al.*, 2025).

Several interview participants highlighted the lack of structured interdepartmental communication, particularly with clinical pharmacists, noting that they had no direct line of contact for real-time prescribing support. Interestingly, the KAP survey revealed that clinicians were less likely to consult pharmacists than books, international resources, or microbiologists when

seeking advice on SAP, underscoring both cultural norms and structural barriers to interdisciplinary collaboration.

The PPS (Chapter 2) revealed that 43 suitable patients did not receive SAP, while among those who did, only half (91/180; 50.5%) received it within the recommended 60 minutes before incision. This is broadly comparable to global findings: adherence to the recommended timing often falls below 60% in both high- and middle-income countries (Gouvea *et al.*, 2015; Khan *et al.*, 2020a; Bardia *et al.*, 2021; Ali *et al.*, 2025). This PPS finding was further explained by the KAP study (Chapter 3), which confirmed limited knowledge, with over half of the participants identifying the correct timing. However, during interviews, most participants agreed that SAP should be administered within 60 minutes of incision and expressed concern about the PPS results. They suggested several possible reasons for the delayed or missed dose of SAP, including systemic issues such as workflow disruptions, poor documentation, emergency surgery and heavy workloads, particularly in public hospitals. These explanations were similar to those reported in several international studies and systematic reviews (Tan *et al.*, 2006; Wæhle *et al.*, 2019; Hassan *et al.*, 2021; Romero Viamonte *et al.*, 2021).

The availability of guidelines represented an additional structural challenge. The PPS revealed that not all participating hospitals had local SAP guidelines, and among those that did, only three had comprehensive documents covering all aspects of prophylaxis. Accessibility of guidelines was also limited, with

clinicians reporting difficulty locating or consulting guidelines during routine practice. The KAP survey and the interviews (Chapters 3 & 4) reinforced this picture: while most participants were aware of the existence of local or international guidelines, many believed that local protocols were outdated, inconsistent, or insufficiently detailed, especially for post-operation prescribing. Participants consistently expressed a need for updated, standardised national guidelines to harmonise practice across institutions in Kuwait, both private/public.

5.3. Strategies to optimise SAP prescribing in Kuwait

Using the COM-B model (Michie *et al.*, 2011), this research demonstrates that inappropriate SAP prescribing in Kuwait is primarily driven by deficits in Opportunity (systemic and cultural), with additional gaps in Capability and influences on Motivation. To translate these behavioural determinants into practical recommendations, the COM-B findings were mapped on to the Behaviour Change Wheel (BCW) a well validated framework for designing behaviour change interventions in healthcare (Michie *et al.*, 2011). The BCW links each COM-B domain to specific intervention functions and policy categories, enabling a systematic approach to identifying strategies, such as education, training, enablement, environmental restructuring, and guideline reinforcement, to address the barriers identified in this study. This structured mapping ensures that proposed interventions are theoretically grounded, evidence-based, and aligned with international best practice in antimicrobial stewardship and behavioural change research (Table 5.1)

Table 5:1: Mapping Barriers and Facilitators to COM-B Domains, BCW Intervention Functions, Policy Categories, and Example Strategies

COM-B Domain	Barriers Identified	Facilitators Identified	BCW Intervention Functions	Policy Categories	Example
Physical Capability	Inconsistent SAP documentation practice.	Electronic systems with reminders.	Training,	Service provision,	Train staff on SAP documentation.
	Reliance on verbal orders and handwritten prescriptions.	Regular documentation training.	Environmental restructuring	Communication /marketing	Implement e-prescribing or structured order sets for SAP
	Self-established protocols over guidelines.	Scientific lectures, induction sessions, handouts.			Mandatory documentation fields in the file/system.
	Lack of regular training and awareness.				
	Knowledge gaps between seniors and newcomers.				

Psychological Capability	Knowledge gaps in SAP guidelines.	Structured training, clear accessible guidelines.	Education, Enablement	Guidelines, Communication /marketing	Deliver structured SAP workshops.
	Overreliance on personal experience.	Risk-based guideline modification.			Disseminate awareness leaflets targeting doctors and patients Disseminate clear local/national guidelines in every wards.
Physical Opportunity	Drug shortages (e.g. cefazolin, esp. during crises).	National standardisation of SAP guidelines.	Environmental restructuring, Enablement,	Guidelines, Regulation, Legislation,	Develop a clear national SAP guideline covering both pre- and post-operative recommendations.
	Absence of national guidelines. Limited access to local protocols. Profit-driven prescribing in private sector.	Digital/hardcopy guideline access. Improved supply chain resilience.	Persuasion, Training	Environmental /social planning	Secure cefazolin supply chain. Align formularies with guidelines recommendations.

Social Opportunity	Hierarchical influence of seniors.	MDT collaboration/ integration into surgical teams (clinical pharmacists, microbiologists, infection control).	Modelling, Persuasion, Incentivisation	Service provision, Guidelines, Communication/marketing	Engage senior consultants as stewardship champions.
	Patient demands and expectations.	Regular audit and feedback.	Education,		Establish MDT Antimicrobial stewardship committees.
	Lack of multidisciplinary input (especially clinical pharmacists).	Patient education on hygiene/wound care.	Environmental restructuring		Patient education campaigns on antibiotic AMR and side effects.
	Weak audit systems.				
	Misconceptions (e.g. allergy).				
Reflective Motivation	Belief in broad-spectrum superiority.	Recognition of AMR risk.	Persuasion, Incentivisation	Communication /marketing,	Use literature data to show benefits of cefazolin.
	Defensive prescribing to avoid blame.	Evidence supporting narrow-spectrum efficacy.	, Modelling	Service provision	Recognise/reward evidence-based prescribing.

	Variable practices across sectors.				
Automatic Motivation	Lack of penalties for non-compliance.	Constructive feedback.	Incentivisation	Regulation,	Provide structured performance feedback.
		Incentives/recognition for adherence.	Feedback	Legislation,	
	Punitive culture discouraging engagement.			Service provision	Introduce penalties for persistent non-compliance.
	Absence of structured appraisals.				Recognition/reward schemes for complaint doctors.

5.4. Implications

5.4.1. Implications for clinical practice and policy

The findings of these studies have significant implications for clinical practice and health policy in Kuwait. At the clinical level, the results demonstrate that inappropriate SAP prescribing is not only due to a lack of knowledge but is also maintained by systemic barriers, defensive behaviours, and deeply rooted institutional norms. This indicates that interventions must extend beyond traditional education to focus on transforming the clinical environment where prescribing decisions occur.

For clinicians, the results emphasise the importance of strengthening interdepartmental communication and adopting a multidisciplinary approach, particularly by embedding pharmacists in perioperative decision-making. The limited involvement of clinical pharmacists, along with unclear role boundaries between surgeons and anaesthetists, led to inconsistent prescribing practice and inadequate documentation. Addressing these concerns will require greater recognition of SAP as a shared responsibility in the surgical team, rather than as an individual prescriber's responsibility.

From a policy perspective, the absence of a unified national guideline and differences in hospital protocols highlight a wider gap in regulatory and institutional oversight. Without clear and accessible SAP guidance, clinicians tend to depend on routines, hierarchy, or defensive practice. Therefore, policymakers should prioritise the development and enforcement of SAP

guidelines as essential components for enhancing quality and ensuring patient safety in perioperative care.

The findings also have implications for antimicrobial stewardship across the health system. Defensive prescribing behaviour, coupled with prolonged and broad-spectrum prescribing of SAP, increase unnecessary antibiotic exposure and increase the risk of antimicrobial resistance. This emphasises the need for stewardship programmes that operate at both hospital and national levels, providing consistent monitoring, feedback, and accountability mechanisms.

Overall, this research indicates that achieving sustainable enhancements in SAP prescribing in Kuwait depends on aligning clinical practice with policy. Clinicians require support through clearer structures, resources, and communication pathways, while policymakers must establish the regulatory and institutional framework to promote and sustain evidence-based prescribing. These elements are illustrated in the SAP prescribing pathway developed from this study (Figure 5.1).

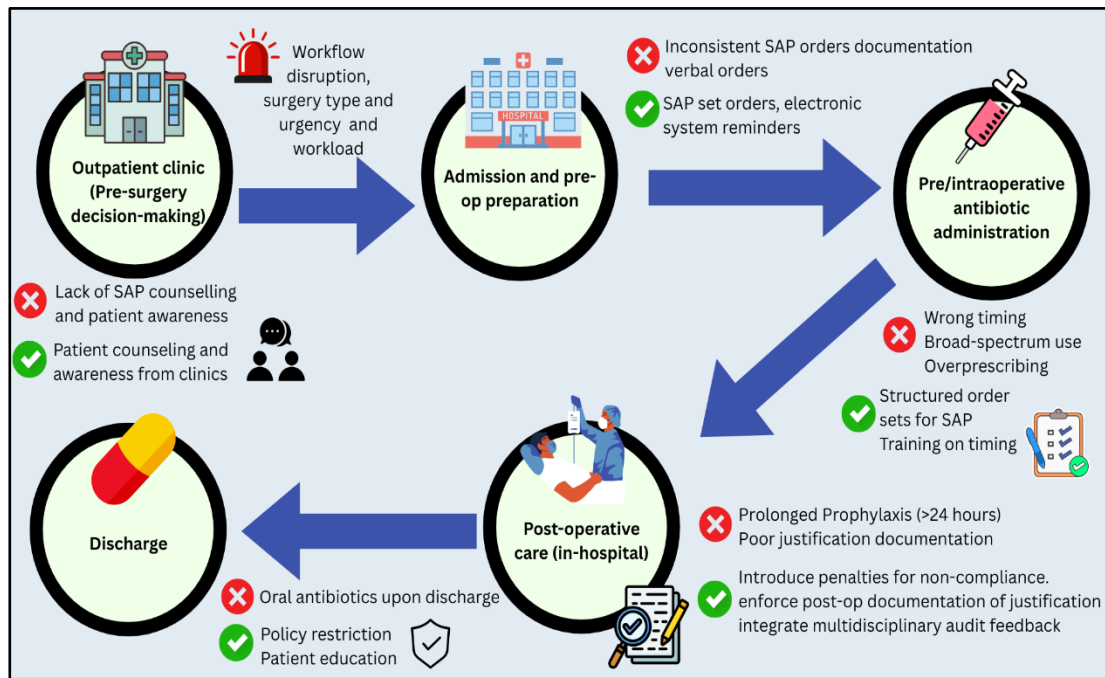


Figure 5.1: SAP Prescribing Pathway Showing Barriers (Red Crosses) and Facilitators (Green Ticks) Identified Across the Patient

5.4.2. Implications for future research

The results of this research highlight several areas for future investigation. First, there is a need for interventional studies to evaluate the impact of proposed strategies, electronic prescribing with decision support, audit and feedback, or national guideline implementation, on SAP adherence and SSI outcomes in Kuwait. Secondly, longitudinal studies should monitor SAP over time, particularly after the roll-out of updated national guidelines, to assess the sustainability of behaviour change. Thirdly, comparative studies across GCC and Middle Eastern countries could provide regional benchmarking and inform a collaborative approach to antimicrobial stewardship in surgery. Future research should also examine SAP prescribing across all surgical specialities, not only OB/GYN, to determine whether similar behavioural and systemic patterns occur in other procedural contexts. In addition, qualitative research exploring patients' expectations and understanding of antibiotic use in surgical

settings could offer insights into how patient-related factors shape prescribing behaviours and support the development of patient-centred AMS interventions. Finally, research on clinical pharmacists' perceptions, readiness, and training requirements for an expanded stewardship role in SAP, especially in pre-operative assessment, intraoperative support, and post-operative review, would help guide workforce development and optimise the contribution of pharmacy professionals to SAP enhancement efforts.

5.5. Strengths and Limitations

5.5.1. Strengths

This thesis has significant strengths. It is the first nationwide, mixed-methods assessment of SAP prescribing in obstetric and gynaecological surgery in Kuwait, combining quantitative approaches (such as PPS, KAP survey) and qualitative methods (interviews). This triangulation facilitated a comprehensive understanding of SAP prescribing, uncovering not only the extent and nature of inappropriate prescribing but also the behavioural and systemic factors that drive it. Including both public and private hospitals, as well as input from different clinician groups, enhances the representativeness of the findings. Moreover, employing established behavioural frameworks (COM-B and BCW) provided a solid theoretical basis for analysis, allowing for clear links between evidence, behaviour, and potential interventions. Notably, this thesis goes beyond identifying the issue by translating COM-B and BCW findings into a set of theory-based, context-specific recommendations for antimicrobial stewardship tailored to Kuwait's healthcare system, offering a practical guide to improve SAP practice nationwide.

5.5.2. Limitations

However, limitations must be addressed. The PPS design, while useful for benchmarking practice, offers only a cross-sectional snapshot and cannot establish causality. The KAP survey was subject to potential response and recall bias, and the overall response rate was low, raising the possibility of selection bias. Additionally, the focus on OB/GYN surgery means that findings may not be directly applicable to other surgical specialties. Lastly, while the integration of mixed methods improved validity, it also added complexity to interpretation, and some findings may reflect contextual nuances unique to the Kuwaiti healthcare system.

5.6. Conclusion

This thesis has provided the first comprehensive, mixed-methods national assessment of SAP prescribing in OB/GYN surgery in Kuwait. Across the PPS, KAP survey, and qualitative interviews, inappropriate practice was found to be widespread and characterised by overprescribing in non-indicated cases, routine use of broad-spectrum agents, prolonged prophylaxis, incorrect timing of administration, incomplete documentation, and variable access to guidelines. These findings were explained and influenced not only by knowledge gaps but also by systemic, cultural, and motivational factors barriers.

By applying the COM-B model, this research identified that the most influential barriers lie in the opportunity domain, including resource limitations, hierarchical influence, a lack of multidisciplinary collaboration, and the absence of standardised national guidelines. Additionally, gaps in capability

and motivation further reinforced the suboptimal practices. Mapping these findings to the BCW highlighted the need for a multi-component response that integrates education and audit with structural reforms such as electronic prescribing, reliable antibiotic supply, clarified prescribing roles, pharmacist involvement, and the development of national guidelines supported by regulation and stewardship oversight.

Taken together, the findings of this thesis emphasise that sustainable improvement in SAP prescribing in Kuwait will require moving beyond individual training to address systemic and cultural issues. By producing strong evidence on both the scale of inappropriate prescribing and the causative factors, this thesis provides a basis for designing and implementing locally tailored stewardship strategies, with implications not only for Kuwait but also for other healthcare systems in the region facing similar issues.

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Appendices

2.1 Patient data collection form

Patient Data					
Survey date	____/____/____	Hospital code		Ward code	
Survey number		Patient unique code		Date of admission	____/____/____
Date of birth	____/____/____	Weight (if available)	_____ Kg	Nationality	☐ Kuwaiti ☐ non-Kuwaiti
NPO before surgery	☐ Yes ☐ No ☐ Unknown		NPO after surgery	☐ Yes ☐ No ☐ Unknown	
Co-morbidities	☐ Cardiovascular ☐ Respiratory ☐ Diabetes (Type 1 and 2) ☐ CNS ☐ Renal/ Endocrine ☐ Pregnancy related complication ☐ Other ☐ No comorbidity		Specify comorbidities:		
Smoking status	☐ Smoker ☐ Non-smoker ☐ Unknown		Allergy to antimicrobials	☐ Not documented ☐ Nil known ☐ Present specify _____	
OBS/GYN surgical procedure data					
Date of surgery	____/____/____	Type of surgery	☐ Emergency ☐ Elective		
Speciality	☐ Obstetrics ☐ Gynaecology		Surgical procedure		
Wound class	☐ Clean ☐ Clean-contaminated ☐ Contaminated ☐ Dirty ☐ Unknown				
Time of initial surgical incision		End time of procedure		☐ Unknown	
Antimicrobial Data					

Antibiotic prophylaxis prior surgery		Antibiotics given within 30-60 min before knife to skin, except for Vancomycin and fluroquinolones where doses are given within 120 min before surgery.				
Antibiotic indicated based on local guideline		☐ Yes ☐ No				
Systemic antibiotic prophylaxis given		☐ Yes, single dose before incision ☐ Yes, multiple doses before incision ☐ Not given ☐ Unknown				
Antibiotic name	Dose in (grams)	Route	Exact timing	Start date	Documentation of AP indication in patient file	
			_____ ☐ Not recorded	___/___/___	☐ Yes ☐ No	
			_____ ☐ Not recorded	___/___/___	☐ Yes ☐ No	
			_____ ☐ Not recorded	___/___/___	☐ Yes ☐ No	
Antibiotic prophylaxis during surgery		Antibiotics given during surgery (Redosing).				
Antibiotic indicated			☐ Yes ☐ No			
Systemic Antibiotic Prophylaxis given during surgery			☐ Yes ☐ No ☐ Unknown			
Antibiotic name	Dose in (grams)	Route	Timing	Documentation of indication patient file	Indication	
				☐ Yes ☐ No	☐ Excessive blood loss ☐ Operation duration > 4 hours ☐ Other specify: _____	
Antibiotic post-surgery	Antibiotics given after surgical procedures to prevent SSI.					
Antibiotic prophylaxis indicated based on local guideline			☐ Yes ☐ No			

Systemic antibiotic given after surgery		☐ Yes, Single dose after surgery ☐ Yes, more than one dose after surgery < 24 hours ☐ Yes, more than one dose after surgery > 24 hours ☐ Not given						
Antibiotic name	Dose in (grams)	Route	Frequency	Start date	End date	Duration	Documentation of reason for extended prophylaxis	Stop/review date in patient file
				__/__/__	__/__/__		☐ Yes ☐ No	☐ Yes ☐ No
				__/__/__	__/__/__		☐ Yes ☐ No	☐ Yes ☐ No
				__/__/__	__/__/__		☐ Yes ☐ No	☐ Yes ☐ No
				__/__/__	__/__/__		☐ Yes ☐ No	☐ Yes ☐ No
Number of total antibiotics prescribed (pre-intra-post)								
HAIs Data								
Development of surgical site infection (SSI)		☐ Yes ☐ No ☐ Unknown						

Hospital data collection sheet

Hospital data

Hospital type	☐ Secondary ☐ Tertiary ☐ Private	Hospital code	
Survey start date	____/____/____	Survey end date	____/____/____
Total number of obstetrics and gynaecology wards		Total number of beds in all obstetrics and gynaecology wards	

Availability of local surgical prophylaxis guidelines for obstetrics and gynaecology	☐ Obstetrics surgery guideline only ☐ Gynaecology surgery guideline only ☐ Both available ☐ No guideline available
--	---

2.2 local and ACOG (2018) guidelines

Hospital	Hospital A		Hospital B		Hospital C	Hospital D	Hospital E	Hospital F	Hospital G	Hospital H	Hospital I		ACOG Guideline	
Antibiotic Prophylaxis Procedure	First line	Second line / OR, penicillin allergy	First line	Second line/penicillin allergy	First line Second line/penicillin allergy	First line Second line/penicillin allergy	Not available ACOG Guideline	First line Second line/penicillin allergy	Not available (ACOG Guideline)	Not available (ACOG Guideline)	First line	Second line/penicillin allergy	First line	Second line/penicillin allergy
Hysterectomy (Vaginal, Laparoscopic abdominal or Robotic assisted)	Single dose IV Cefuroxime 1g at the time of induction	Single dose IV 900mg clindamycin at the time of induction	Cefazolin 1g at the time of induction	Co-amoxiclav 1.2g at the time of induction	Not available ACOG Guideline	Not available		A single dose of Cefuroxime 1.5g IV or Ceftriaxone 1-2g IV Before surgery			Single dose 60min before surgery IV 2g Cefazolin or 1.5g Cefuroxime ±	A single dose before surgery IV 1.5mg Cefuroxime ± 500mg Metronidazole	2g of Cefazolin in single dose 1 hour before the procedure (for over 120Kg 3g	Penicillin anaphylaxis: A single dose of Clindamycin 900mg or 500mg of

											500mg Metronidazole	If Allergic : A single dose of Clindamycin 900mg or 500mg of Metronidazole Plus 5mg/Kg Gentamicin	cefazolin) Or 1.5g Cefuroxime	Metronidazole Plus 5mg/Kg Gentamicin Or 2g Aztreonam Within 1 hour before surgery
Caesarean section (Emergency and Elective)	Single dose IV cefuroxime 1.5g Or 1 gram of Cefazolin at the time of cord clamping For suspension of anaerobes	Single dose IV 900mg clindamycin Before surgery, within 60min	Single dose Cefazolin 1g IV for patient <80 Kg Cefazolin 2g IV for patient >	Penicillin allergy : single dose Clindamycin 900mg Plus Gentamicin 1.5g IV Within 60min before surgery	Cefuroxime 1.5g before surgery, then 750mg IV TDS for 48 hours ADD Azithromycin 1g Stat for a patient in labour	Alternative: Ampicillin 2g QDS for 48 hours. In the case of MRSA A single dose of Vancomycin 1.5g IV	Single dose IV 1.5g cefuroxime before surgery		A single dose of Cefuroxime 1.5g IV or Ceftriaxone 1-2g IV Or Co-amoxiclav 1.2g IV Within 30-60		Single dose IV 2g Cefazolin Or 1.5g Cefuroxime 60min before surgery	900mg Clindamycin + 5mg/Kg gentamicin	2g of Cefazolin single dose 1 hour before procedure (for over 120Kg 3g cefazolin) Add 500mg of Azithromycin	Penicillin anaphylaxis: A single dose of Clindamycin 900mg or 500mg of Metronidazole Plus 5mg/Kg Gentamicin

	bic infection, add Metronidazole 500mg of at the time of cord clamping (Antibiotics can be extended for up to 24 hours in special cases such as prolonged surgery, adhesion or significant bleeding)		80Kg Within 60min before surgery		and ROM. Post operation on discharge: Mandatory 7-day course of Co-amoxiclav 1 BD	before surgery			min before surgery or after cord clamping (for co-amoxiclav and cefuroxime only) Penicillin anaphylaxis: Clindamycin 600mg IV Within 30-60 min before surgery					for emergency c-section. Or as soon as possible after the incision is made (in emergency cases)	Or 2g Aztreonam Within 1 hour before surgery. For Obese women who did not receive IV Azithromycin: Consider post-operative oral therapy of 500mg cephalexin and 500mg metronidazole for 48 hours
Uterine Evacuation (Surgical)	Single dose IV 1.5g	Single dose IV 900mg clindamycin			Not available ACOG Guideline	Not available			A single dose of Cefurox			Single dose before surgery	Oral 400mg Metronidazole	A single oral dose of	A single dose of 400mg

Abortion) (E&D, D&C)	cefuroxime At the time of induction	For septic miscarriage, IV gentamicin 3-5mg/Kg + Metronidazole 500mg 2 hours before evacuation. Alternative, Clindamycin 900mg+Metronidazole 500mg			ACOG Guideline		ime 1.5g IV or Ceftriaxone 1-2g IV Before surgery			Oral 100 mg Doxycycline Then 200mg post-surgery	Alternative if B-lactam allergy: Azithromycin	200mg of Doxycycline before surgery	of oral Metronidazole before surgery
Laparoscopic Colporrhaphy (anterior/posterior/classical) And vaginal sling placement	Single dose IV 1.5g cefuroxime At the time of induction	Single dose IV 900mg clindamycin	Not available ACOG Guideline	Not available ACOG Guideline	Not available ACOG Guideline		A single dose of Cefuroxime 1.5g IV or Ceftriaxone 1-2g IV Before surgery			Single dose of IV 2g Cefazolin Or 1.5g Cefuroxime + 500mg Metronidazole Before surgery	A single dose of IV 900mg Clindamycin Before surgery	A single dose within 60min before the procedure 2g of Cefazolin (for over 120Kg 3g cefazolin Or 1.5g Cefuroxime	Penicillin anaphylaxis: A single dose of Clindamycin 900mg or 500mg of Metronidazole Plus 5mg/Kg Gentamicin Or 2g Aztreonam

													Within 1 hour before surgery
Laparotomy procedures without entry into the bowel or vagina (e.g., laparotomy Myomectomy and laparotomy Ovarian Cystectomy)	Single dose IV 1.5g cefuroxime at the time of induction	Single dose IV 900mg clindamycin	Not available ACOG Guideline	Not available ACOG Guideline	Not available ACOG Guideline		A single dose of Cefuroxime 1.5g IV or Ceftriaxone 1-2g IV Before surgery			Single dose within 60 min before surgery : 2g Cefazolin Or 1.5g Cefuroxime	900mg Clindamycin + 5mg/Kg gentamicin	2g of Cefazolin in single dose 1 hour before the procedure (for over 120Kg 3g cefazolin	Penicillin anaphylaxis: A single dose of Clindamycin 900mg or 500mg of Metronidazole Plus 5mg/Kg Gentamicin Or 2g Aztreonam Within 1 hour before surgery

Laparoscopic procedures without entry into the bowel or vagina (BLT, Laparoscopic Myomectomy or ovarian cystectomy or ectopic pregnancy)	Not available ACOG Guideline	Not available ACOG Guideline	Not available ACOG Guideline	Not available ACOG Guideline		Not available ACOG Guideline			Not recommended	Not recommended
Hysteroscopy (diagnostic or operative)	Not available ACOG Guideline	Not available ACOG Guideline	Not available ACOG Guideline	Not available ACOG Guideline		Not available ACOG Guideline			Not recommended	Not recommended
D&C for non-pregnancy indications Endometrial biopsy Oocyte retrieval, Manual removal or placenta	Not available ACOG Guideline	Not available ACOG Guideline	Not available ACOG Guideline	Not available ACOG Guideline		Not available ACOG Guideline			Not recommended	Not recommended

2.3 Ministry of Health ethical approval for PPS



دولة الكويت
وزارة الصحة
وكيل الوزارة المساعد لشئون التخطيط والجودة



المرجع : ٣٣٢٠
التاريخ : ٢٠٢٢ / ١٠ / ٢١

السيد الفاضل / د. وكيل الوزارة
المحترم
تحية طيبة وبعد،،،،،

الموضوع / تسهيل مهمة الباحث / فهد أحمد الشطي – طالب دكتوراة في جامعة
سترثكلايد – جلاسكو
تحت إشراف

Dr. Amanj Kurdi – Professor / Anne Boyter –
(رقم البحث 2022/ 2119) تحت عنوان:

National assessment of the prescribing practice of
antimicrobial prophylaxis for gynaecological and obstetric
surgeries in public hospitals in Kuwait: A point prevalence
survey

يرجى التفضل بالإحاطة بأن اللجنة الدائمة لتنسيق البحوث الطبية والصحية
المشكلة بموجب القرار الوزاري رقم 207 لسنة 2012 قد أوصت بإجتماعها
الثامن والثمانون (6/ 2022) المنعقد يوم الثلاثاء الموافق 2022/10/25
بالموافقة على إجراء البحث المقدم من الباحث بتاريخ 2022/9/22.
وذلك بعد أن قامت اللجنة استنادا للقرار الوزاري رقم 207 لسنة 2012 والتعميم
الصادر من السيد / وكيل الوزارة برقم 156 لسنة 2012 باستطلاع آراء الجهات
ذات العلاقة بموضوع البحث حيث وافق السيد / أ. المستشار القانوني بالكتاب
رقم 1015 بتاريخ 2022/10/19 كما وافق السيد / د. رئيس مجلس أقسام النساء والتوليد
بالكتاب رقم 1037 بتاريخ 2022/10/20.
ويتم البحث من خلال استخدام نموذج لجمع البيانات عن المؤشرات المستهدفة
بالدراسة حسب بروتوكول البحث.

2.3 University of Strathclyde Ethical approval



STRATHCLYDE INSTITUTE OF PHARMACY & BIOMEDICAL SCIENCES

Mr Fahad Alshatti
Strathclyde Institute of Pharmacy and Biomedical Science
University of Strathclyde
Glasgow

12th December 2022

Dear Fahad,

Ethical review of research project "National assessment of the prescribing practice of antimicrobial prophylaxis for gynaecological and obstetric surgeries in public hospitals in Kuwait"

I confirm that the request for ethical approval (EA22-13) for the above project has been reviewed by the SIPBS Departmental Ethics Committee and no unaddressed issues were identified. The project therefore has ethical approval.

Regards,

A handwritten signature in blue ink that reads "Christopher Prior".

Dr Christopher Prior
Convenor, Departmental Ethics Committee
Strathclyde Institute of Pharmacy and Biomedical Sciences
University of Strathclyde
116 Cathedral Street
Glasgow
G4 0NR

(44) 141 548 2459
c.b.prior@strath.ac.uk

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3.1 KAP survey

Consent Form

Name of department: Strathclyde Institute of Pharmacy and Biomedical Sciences (SIPBS).

Title of the study: Knowledge Attitude and Practice (KAP) of Gynaecologists and Obstetricians towards surgical antimicrobial prophylaxis (SAP) in Public and Private Hospitals in Kuwait

Please read the consent statements below, and if you would like to participate, tick “Agree” below. If you do not want to participate, tick disagree.

- I confirm that I have read and understood the Participant Information Sheet for the above study, and the researcher has answered any queries to my satisfaction.
- I confirm that I have read and understood the Privacy Notice for Participants in Research Projects and understand how my personal information will be used and what will happen to it (i.e., how it will be stored and for how long).
- I understand that my participation is voluntary and that I am free to withdraw from the project at any time, up to the point of completion, without giving a reason or without any consequences.
- I understand that anonymised data (i.e., data that do not identify me personally) cannot be withdrawn once they have been included in the study.
- I understand that any information recorded in the research will remain confidential, and no information that identifies me will be made publicly available.

I consent to be a participant in the project.

☐ I agree

☐ I disagree

Researchers' contact details:

Fahad Alshatti

PhD student

Fahad.alshatti@strath.ac.uk

telephone: +96550664004/ +440744222130

Strathclyde Institute of Pharmacy and Biomedical Sciences (SIPBS),

University of Strathclyde,

161 Cathedral St, Glasgow G4 0RE

Glasgow, United Kingdom

Participant Information Sheet

Name of department: Strathclyde Institute of Pharmacy and Biomedical Sciences (SIPBS)

Title of the study: Knowledge, Attitude and Practice (KAP) of Gynaecologists and Obstetricians towards surgical antimicrobial prophylaxis (SAP) in Public and Private Hospitals in Kuwait

Introduction

I am Fahad Alshatti, and I am a PhD student at the Strathclyde Institute of Pharmacy and Biomedical Sciences (SIPBS) at the University of Strathclyde, Glasgow, Scotland, UK. My email: is Fahad.alshatti@strath.ac.uk

What is the purpose of this research?

This research aims to assess the knowledge, attitudes, and practice of gynaecologists and obstetricians in Kuwait's public and private hospitals toward SAP. This study is part of a PhD project which aims to describe and improve the prescribing of surgical antibiotic prophylaxis in Kuwait, with the ultimate goal of reducing the incidence of antimicrobial resistance and surgical site infections.

Do you have to take part?

Participation in this research is entirely voluntary. All participants have the right to refuse participation or stop participating in the study at any time and without any detriment. Withdrawing your participation from this study will have no impact on your work.

What will you do in this research?

Participation in this study involves completing a paper-format questionnaire, which takes 10-15 minutes to complete. The questionnaire will ask about your understanding, attitudes, and habits related to prescribing antibiotic prophylaxis. Please answer the questionnaire based on your knowledge and opinion without consulting other people or external resources such as the internet, books, or any other resources.

Why have you been invited to take part?

You are invited to take part because you are involved in obstetric and

gynaecological surgery. Please take time to read this information before completing the survey. If you agree, your participation is appreciated.

What information is being collected in this research?

The questionnaire will only collect information regarding your opinions and experiences in relation to SAP. No personal identifiable information will be collected, and your responses will be anonymised.

Who will have access to the information?

Only the PhD student and their PhD supervisors will have access to any data. All data collected will be anonymised, and your participation will be confidential.

Where will the information be stored, and how long will it be kept for?

All data will be stored securely on a secure remote drive provided by the University of Strathclyde. Data will be stored for a minimum of 10 years.

Thank you for reading this information – please ask any questions if you are unsure about what is written here by contacting me (details below)

All personal data will be processed in accordance with data protection legislation.

Please read our [Privacy Notice for Research Participants](#) for more information about your rights under the legislation.

What happens next?

By completing the questionnaire, you are giving your consent to participate in this study. You may withdraw from the study at any time by not submitting the survey. The results of this study will be published. If you would like to see the publication, please contact the investigator (details below).

Chief Investigator / PhD supervisor details:

Dr. Amanj Kurdi

Senior Lecturer

+00 (0)141 548 2181

amanj.baker@strath.ac.uk

Strathclyde Institute of Pharmacy and Biomedical Sciences (SIPBS),

University of Strathclyde,

161 Cathedral St, Glasgow G4 0RE

Ethical Approvals

The Ministry of Health of Kuwait granted this research ethical approval, and it was endorsed by the SIPBS ethical committee.

If you have any questions/concerns during or after the research or wish to contact an independent person to whom any questions may be directed or further information may be sought, please contact:

Secretary to the University Ethics Committee

Research & Knowledge Exchange Services

University of Strathclyde

Graham Hills Building

50 George Street

Glasgow
G1 1QE
Telephone: 0141 548 3707
Email: ethics@strath.ac.uk

Demographic

1. What is your gender?

- ☐ Male
☐ Female
☐ Prefer not to say.

2. What is your age?

(Please specify in years) _____

3. What is your speciality?

(Please select one)

- ☐ Obstetrics and Gynaecology
☐ Anaesthesiology
☐ Other (Please specify _____)

4. From which continent did you obtain your medical degree?

(Please select one)

- ☐ Middle East (Please specify _____)
☐ Europe (Please specify _____)
☐ North America (Please specify _____)
☐ Asia (Please specify _____)
☐ Other (Please specify _____)

5. How many years is it since you graduated from medical school?

Specify in years _____

6. Where do you work?

(Select as many as applicable)

- ☐ Public hospital
☐ Private hospital

7. What is your current level of practice?

(Please select one)

- ☐ Consultant
☐ Fellow
☐ Senior registrar
☐ Registrar
☐ Board (please specify _____)
☐ Trainee

8. Which surgical prophylaxis guidelines are you aware of?
(Select all that are applicable)

- ☐ National
- ☐ Local hospital guideline
- ☐ International (Please specify_____)
- ☐ None of the above (Please specify_____)

9. Which surgical prophylaxis guidelines are you using?
(Select all that are applicable)

- ☐ National
- ☐ Local hospital guideline
- ☐ International (please specify_____)
- ☐ None of the above (please specify_____)

Knowledge:

Please answer the questionnaire based on the best of your knowledge regarding surgical antibiotic prophylaxis based on the American College of Obstetrics and Gynaecology (ACOG) guideline, without consulting external resources such as the internet, books, or any other resources. Your response will help to identify any knowledge gaps to facilitate a targeted educational intervention.

1. For the surgical procedures below, which require antimicrobial prophylaxis?

(Please select all that are appropriate)

- ☐ Clean (non-prosthetic procedure)
- ☐ Clean (with prosthetics placement or implants)
- ☐ Clean-contaminated
- ☐ Contaminated
- ☐ Dirty
- ☐ I don't know.

2. From the following procedures, which would you prescribe antibiotic prophylaxis for? (Please select all that are appropriate)

- ☐ Colporrhaphy
- ☐ D&C for non-pregnancy indications
- ☐ Elective Caesarean section
- ☐ Emergency Caesarean section
- ☐ Endometrial Biopsy
- ☐ Hysteroscopic procedures
- ☐ Intrauterine device insertion
- ☐ Laparoscopic myomectomy
- ☐ Robotic hysterectomy
- ☐ Uterine evacuation to induce abortion (Dilation and curettage)
- ☐ I don't know.

3. The number of doses of antibiotic prophylaxis is:

(Please select one)

- ☐ One dose
- ☐ 1-2 doses
- ☐ More than two doses
- ☐ I don't know.

4. The appropriate timing for administering surgical antibiotic prophylaxis is:

(Please select one)

- ☐ More than 60 min before incision
- ☐ During surgery
- ☐ Post-surgery
- ☐ Less than 60 min before incision
- ☐ I don't know.

5. According to the ACOG guideline, the first-line antibiotic for surgical prophylaxis for obstetric and gynaecological surgery is:

(Please select one)

- ☐ Co-amoxiclav
- ☐ Cefazolin
- ☐ Ceftriaxone
- ☐ Cefuroxime
- ☐ Gentamicin
- ☐ I don't know.

6. In the case of an immediate hypersensitivity reaction to penicillin, according to ACOG guidelines, the recommended

antibiotic prophylaxis is:

(Please select one)

- ☐ Clindamycin + cefazolin
- ☐ Clindamycin alone
- ☐ Gentamicin + metronidazole
- ☐ Vancomycin
- ☐ I don't know.

7. The appropriate timing to administer co-amoxiclav for C-section surgery is:

(Please select one)

- ☐ Before surgery
- ☐ Before and after surgery
- ☐ During surgery, after clamping the cord
- ☐ I don't know.

8. The appropriate timing for administering metronidazole in case of suspected anaerobic infection is:

(Please select one)

- ☐ A single dose before surgery
- ☐ Multiple doses post-surgery for up to 24 hours
- ☐ Multiple doses post-surgery for up to 3 days
- ☐ I don't know.

9. The appropriate duration of antibiotic prophylaxis is:

(Please select one)

- ☐ A single dose.
- ☐ Up to 24 hours post-surgery
- ☐ Up to 48 hours post-surgery
- ☐ Up to 3 days post-surgery
- ☐ Up to 1 week post-surgery
- ☐ I don't know.

10. Antibiotic prophylaxis can contribute to the spread of antimicrobial resistance. Is this true?

(Please select one)

- ☐ Yes
- ☐ No
- ☐ I don't know.

Attitude

To what extent do you agree with the following statements? Please select one response per statement.	Strongly disagree	Somewhat disagree	Neither	Somewhat agree	Strongly agree
Doctors should follow antibiotic prophylaxis guidelines for patients receiving obstetric or gynaecological surgery					
Doctors should prescribe a single dose of antibiotic prophylaxis within 60 mins of the start of surgery					
Broad-spectrum antibiotics are better than narrow spectrum antibiotics for surgical prophylaxis					
The operation rooms do not meet the standards of aseptic technique					
Surgical staff fail to adhere to surgical protocols for prescribing antibiotic prophylaxis					
The duration of antibiotic prophylaxis depends on the patient's level of hygiene					
Prolonging antibiotic prophylaxis is important to reduce surgical site infection.					
Administering antibiotic prophylaxis before a C-					

section can have long-term side effects on the baby

Doctors should not be restricted in the selection of antibiotic type and durations

Administering inappropriate antibiotic prophylaxis can increase antimicrobial resistance.

I believe that the local antibiotic prophylaxis guidelines in Kuwait are outdated.

There should be a national guideline for surgical antibiotic prophylaxis

Practice:

To what extent do you agree with the following statements? Please select one response per statement.	Never	Rarely	Sometimes	Most of the time	Always
I am responsible for prescribing antibiotic prophylaxis.					
I usually check if the patient received antibiotic prophylaxis before the procedure.					
I prescribe a single dose of antibiotic prophylaxis before an obstetric or gynaecological surgery.					
I prefer combining cefuroxime and metronidazole as antibiotic prophylaxis for all my patients.					
I document antibiotic prophylaxis orders/prescriptions in the file or medication chart before every procedure.					
I prescribe antibiotics in the post-surgery orders.					
I document the stop date of post-surgery antibiotics.					
I adhere to the hospital's local guidelines.					

- I deviate from antibiotic prophylaxis guidelines to save cost.
- I deviate from antibiotic prophylaxis guidelines when the recommended antibiotics are unavailable.
- I deviate from antibiotic prophylaxis guidelines due to other influences (e.g., Senior doctors).
- I consult the pharmacist about the selection, dose, or timing of surgical antibiotic prophylaxis
- I consult the microbiologist about the selection, dose, or timing of surgical antibiotic prophylaxis
- I refer to medical resources (such as medical books, articles, or medical apps) before prescribing surgical antibiotic prophylaxis.

12- What is the best strategy to optimise surgical antibiotic prophylaxis practice in Kuwait?

Please rank the following question, with 1 as the most and 5 as the least important strategy, by typing the number once next to each of the statement below into your preferred order.

- _____ Staff training and education
- _____ Audit and feedback from clinical pharmacists
- _____ Research
- _____ Antimicrobial stewardship implementation
- _____ Developing a national guideline.

-Thank you for your participation in this study-

3.2 Ministry of Health of Kuwait ethical approval for KAP study



دولة الكويت
وزارة الصحة
وكيل الوزارة المساعد لشئون التخطيط والجودة



المرجع : ٣٢١١

التاريخ : ٢٠٢٢/١٠/٢٤

المحترم

السيد الفاضل / د. وكيل الوزارة

تحية طيبة وبعد،،،

الموضوع / تسهيل مهمة الباحث / فهد أحمد الشطي – طالب دكتوراة في جامعة
ستراثكلاند – جلاسكو
تحت إشراف

Dr. Amani Kurdi – Professor / Anne Boyter –
(رقم البحث 2022/2118) تحت عنوان:

Knowledge Attitude and Practice (KAP) of gynaecologists and
obstetricians towards surgical antimicrobial prophylaxis (SAP) in
public hospitals in Kuwait

يرجي التفضل بالإحاطة بأن اللجنة الدائمة لتنسيق البحوث الطبية والصحية
المشكلة بموجب القرار الوزاري رقم 207 لسنة 2012 قد أوصت باجتماعها
الثامن والثمانون (6/ 2022) المنعقد يوم الثلاثاء الموافق 2022/10/25
بالموافقة على إجراء البحث المقدم من الباحث بتاريخ 2022/9/22.
وذلك بعد أن قامت اللجنة استنادا للقرار الوزاري رقم 207 لسنة 2012 والتعميم
الصادر من السيد / وكيل الوزارة برقم 156 لسنة 2012 باستطلاع آراء الجهات
ذات العلاقة بموضوع البحث حيث وافق السيد / أ. المستشار القانوني بالكتاب
رقم 1014 بتاريخ 2022/10/19 كما وافق السيد / د. رئيس مجلس أقسام النساء والتوليد
بالكتاب رقم 1037 بتاريخ 2022/10/20.
ويتم البحث من خلال استخدام استبيان لجمع البيانات عن المؤشرات المستهدفة
بالدراسة حسب بروتوكول البحث.

4.1 and 4.2 invitation letter and topic guide

Letter Subject: An invitation to participate in research study.

The primary means of disseminating the invitation letter will be via email or phone text.

Dear Doctor _____,

My name is Fahad Alshatti I am a PhD student in the Strathclyde Institute of Pharmacy and Biomedical Sciences (SIPBS) at the University of Strathclyde, Glasgow, UK.

I am contacting you as you are either an obstetrician/gynaecologist or an anaesthesiologist involved in prescribing surgical antibiotic prophylaxis in Kuwait. I am conducting qualitative research using a semi-structured interview to identify the facilitators and barriers to appropriate surgical antimicrobial prophylaxis and guidelines adherence in Kuwait. My overall research aims to improve the quality of surgical antibiotic prophylaxis prescribing in Kuwait.

I have attached to this email a copy of the Participant Information Sheet, which tells you all about the study. Taking part would involve completing an interview with myself. The interview will take place either online (via Zoom® or Microsoft Teams®) or in person face-to-face in your hospital or any place of your convenience. The interview will last for a maximum of 60 minutes. Participation is entirely voluntary. If you took part, you would have the right to withdraw from the study at any time. There is no incentive or detriment to you if you choose/choose not to participate.

The information provided during the interview would be anonymised, and any sensitive information would be kept confidential.

If you wish to participate, please fill out the form in the link below. You will be asked to read the participant information sheet, provide your consent, and fill in your demographics before the interview to arrange a suitable time and place to conduct the interview.

https://strathsci.eu.qualtrics.com/jfe/preview/previewId/c8e75a4f-039c-4883-988e-584609b8d6c6/SV_6fMhuKMu83Hy1kW?Q_CHL=preview&Q_SurveyVersionID=current

Thank you for taking the time to read this email.

Kind Regards,

Fahad Alshatti

Fahad Alshatti

PhD Student

Fahad.alshatti@strath.ac.uk

Telephone: 50664004

Interview guide

Investigator Introduction:

I'm Fahad Alshatti, a clinical pharmacist at Farwaniya Hospital and a PhD student in pharmacy practice at the University of Strathclyde. I am performing a national research in all OB/GYN departments in Kuwait in the private and public sectors to investigate the quality of SAP prescribing in Kuwait and to improve the practice eventually.

In this interview, I would like your opinion and beliefs towards your SAP practice and the facilitators and barriers to appropriate SAP use and compliance with SAP guidelines.

This interview will last for up to a maximum of 60 minutes. The interview will be (audio/video) recorded, and all sensitive information will be kept confidential. You will be anonymous in the reporting of this research.

There are no wrong answers, so please answer according to your knowledge, experience, or belief.

Can I check that you have read the Participant Information Sheet and filled the demographic form?

Do you have any questions? (Check that they have, answer questions, and ensure signed consent is provided).

Are you happy to proceed?

Introduction:

If they didn't complete the demographic form

1. Could you please introduce yourself?
 - a) PROMPT: what is your speciality
 - b) PROMPT: How many years of experience do you have?
 - c) PROMPT: In which sector do you work? Do you practice at a private hospital?

PART 1: Current knowledge and practice:

Section 1: **Knowledge** about Surgical antibiotic prophylaxis (**overall**)

2. Could you please tell me what is your understanding of the purpose of prescribing Surgical antibiotic prophylaxis?

Section 2: **Knowledge** about Surgical antibiotic prophylaxis **indication**

3. For which surgical procedures do you usually prescribe SAP?
 - a) PROMPT: Why?
 - b) PROMPT: What are your thoughts on prescribing SAP for clean surgery?

Section 3: Surgical antibiotic prophylaxis **responsibility**

1. Who do you think should be responsible for prescribing SAP?
 - a. PROMPT: Why

Section 4: Current prescribing **Practice** of Surgical antibiotic prophylaxis

2. Could you tell me what is your current prescribing practice for surgical antibiotic prophylaxis?

Section 5: Practice about Surgical antibiotic prophylaxis **timing**

3. When do you usually prescribe SAP in relation to time to knife for patients undergoing OB/GYN surgery?
 - a) PROMPT: **If post/during surgery, why?**
 - b) PROMPT: **If before surgery, why?**
 - d)

Section 6: Practice about SAP **selection**

4. Could you tell me what is your choice of Surgical antibiotic Prophylaxis (SAP) for pre-operation OB/GYN surgeries?

Ask the following in relation to whether they answer Narrow or Broad-spectrum antibiotics (including Tazocin/ ceftriaxone, etc),

- a) PROMPT: Why?
- b) PROMPT: What do you think about broad versus narrow-spectrum for SAP in OB/GYN operations?

Section 7: Practice about SAP selection in case of **hypersensitivity**

5. Please tell me about your choice of antibiotic if the patient has a known immediate hypersensitivity reaction to penicillin.
 - a) PROMPT: What do you choose, and why?
 - b) PROMPT: What do you think are the difficulties that doctors experience when selecting appropriate antibiotics for these types of patients?

- c) PROMPT: Who do you think should be responsible for prescribing SAP for allergic patients, and why?

Section 8: Practice about Surgical antibiotic prophylaxis duration post-operation

6. How many doses of antibiotic prophylaxis do you prescribe for patients undergone Obstetrics and gynaecology (OB/GYN) Post-surgery per patient?
- a) PROMPT: If there is NO post-op dose, OR if up to 24 hours post-op, why?
- b) PROMPT: If more than 24 hours post-operation,
- Why?
 - For what patients do you do this for? Some / all/certain ones? And why?

Section 9: Awareness and practice of guidelines

7. How do you come to a decision when prescribing SAP for OB/GYN patients?
- a) PROMPT: What do you use, if anything, to help you make your decision?

Adapt the below prompts whether they mention/do not mention guidelines:

- a) *PROMPT: Ask about guideline access - can they/do they access?*
- b) *PROMPT: Which guideline do you follow, if any?*
- c) *PROMPT: How useful do you find the guideline(s), if any?*
- d) What do you think are the possible benefits of adhering to guidelines when prescribing SAP? Why?
- e) PROMPT: If not useful, why not?

If the answer is based on experience or superiority advice:

- a) *PROMPT: Who would you consult for advice?*
- b) *PROMPT: Why?*

Section 10: practice influences

8. Could you tell me what factors influence your SAP prescribing practice?

If mentioned Colleagues? Patients? Infection control? Etc...

- a) PROMPT: Why are these factors influential?
- b) PROMPT: How have they influenced you?
- c) PROMPT: Could you share an example?

PART2: opinions regarding common SAP practice in Kuwait

I conducted a Point prevalence survey study in which I surveyed 9 hospitals in Kuwait, including all public hospitals (5 hospitals) and 4 well-known private hospitals.

I have noticed several SAP practices, and I want your opinion and thoughts regarding them.

Section 11 timing:

Firstly, I have found that only 40% of the patients received initial SAP within 1 hour of the surgery, 60% either during or post-surgery.

1. What do you think about such practice?
2. Why might this is happening, in your opinion?

Most of the 60% were elective surgeries:

3. What do you think about such a practice?
4. Why might elective surgeries most commonly given SAP during or post-surgery, in your opinion?

Section 12 selection:

Secondly, in my PPS, I noticed that broad-spectrum antibiotics are more commonly prescribed pre-operation in private hospitals.

1. What do you think about such a practice?
2. Why might doctors in private hospitals prescribe broad-spectrum antibiotics for OB/GYN surgical prophylaxis, in your opinion?

Section 13 post-operation selection and duration (IF NOT previously answered it in the practice section)

Thirdly, after surgery, there were over 80% of the patients received IV surgical antibiotic prophylaxis for more than 24 hours and often exceeding two days.

1. What do you think about such a practice?
2. Why might doctors do this, in your opinion??

Almost all the patients who received post-op SAP were a combination of Metronidazole and either cefuroxime or ceftriaxone.

1. What do you think about such a practice? And why might this happen?
2. Could you tell me about your prescribing of metronidazole for surgical prophylaxis?
 - a. PROMPT: What do you do, and why?
 - b. PROMPT: How important (or not) do you think covering anaerobic infection for OB/GYN surgery is?
3. If not prescribing, what do you think about this selection of antibiotics post-operation?
 - a. PROMPT: Why do you think metronidazole might be a commonly used medication for SAP, in your opinion?
 - b. PROMPT: How important (or not) do you think covering anaerobic infection for OB/GYN surgery is?

Section 14 Compliance with Guidelines:

The overall compliance with guidelines was low as the overall compliance of SAP was only 8%

4. What do you think about this?
5. Why might this be, in your opinion?

PART 3: AMR knowledge and Barriers and Facilitators of appropriate SAP prescribing

Section 15 AMR knowledge

1. Please tell me any thoughts or any knowledge you have, on the issue of AMR in Kuwait?

Section 15 Barriers

2. From your perspective, what are the barriers that prevent the appropriate prescribing of SAP in Kuwait?
 - a. PROMPTS: Environmental? Resource? Economic? Other?
 - b. PROMPT: why?
 - e)

Section 16: Facilitators

1. What, if anything, have you done in your own practice to optimise SAP prescribing?
 - a. Prompt: was it successful? YES= How/why, NOT = why?
2. From your perspective, what would need to be done to optimise SAP prescribing in Kuwait?
 - a. PROMPT: why these strategies?

Section 17: Ending of the interview

1. Do you have anything you would like to add or say?
 - f) We have reached the end of the interview. Thank you for your valuable time.

-END of interview-

4.3 and 4.3 Consent form and demographic form

Qualitative interviews demographics

Start of Block: 1.Participant information sheet and consent form

Q1.1 Participant Information Sheet

Name of department: Strathclyde Institute of Pharmacy and Biomedical Sciences
(SIPBS)

Title of the study: Barriers and Facilitators of Appropriate Surgical Antibiotic Prophylaxis in Gynaecological and Obstetric Surgery in Kuwait

Introduction

I am Fahad Alshatti, a PhD student in the Strathclyde Institute of Pharmacy and Biomedical Sciences (SIPBS) at the University of Strathclyde, Glasgow, Scotland, UK. My email is Fahad.alshatti@strath.ac.uk

What is the purpose of this research?

This research aims to identify and explore barriers and facilitators for appropriate surgical antibiotic prophylaxis (SAP) prescribing and guideline compliance. This study is part of my PhD research, which aims to describe and improve the prescribing of surgical antibiotic prophylaxis in Kuwait, with the ultimate goal of reducing the incidence of antimicrobial resistance and surgical site infections.

Do you have to take part?

Participation in this research is voluntary. All participants have the right to refuse to participate or withdraw from the study without any detriment. Withdrawal from this study will not alter how participants are treated.

What will you do in this research?

Participation in this study involves a face-to-face interview or virtual interviews with the primary investigator, lasting for up to a maximum of 45 minutes. The interview will be recorded and will be semi-structured with a pre-prepared interview schedule that asks your opinion and practice of prescribing SAP and the common barriers and facilitators to appropriate SAP prescribing and guideline adherence.

Why have you been invited to take part?

You are invited to the interview because you are involved in prescribing surgical antibiotic prophylaxis (SAP) for obstetric and gynaecological surgery. You are eligible if you are a clinician responsible for prescribing surgical antibiotic

prophylaxis (SAP) for patients undergoing gynaecology and obstetrics surgery.

Please take time to read the information before participating in the interview. It will be highly appreciated if you take part in this research.

What information is being collected in this research?

This research will collect demographic information about you, such as your name, age, gender, and your job role but you will remain anonymous throughout the reporting of this study. In addition, the study will collect information regarding your opinions and experiences of SAP.

What are the potential risks?

There are no anticipated risks to you participating in this study.

Who will have access to the information?

Only the PhD student and their PhD supervisors will have access to data. All data collected will be kept confidential.

Where will the information be stored, and how long will it be kept?

All recordings will be transcribed and stored securely on an online storage provided by the University of Strathclyde. The recordings and transcriptions will be stored for a minimum of 10 years. All personal data will be processed in accordance with the UK and Kuwait's data protection legislation. Please read the Privacy Notice for Research Participants and Data Protection Privacy Regulation for more information about your rights under the legislation.

What happens next?

Thank you for reading this information – please feel free to contact me if you have any questions about what is written here.

If you choose to participate, you must sign a consent form before the interview to allow the primary investigator to use any recording for data analysis. You may withdraw from the study anytime by contacting the primary investigator to withdraw your participation and delete any recordings. The results of this study will be published. If you would like to see the publication, please contact the investigator.

If you choose not to participate, I thank you for your time so far.

Researchers' contact details:

Fahad Alshatti

PhD research student

Fahad.alshatti@strath.ac.uk

telephone: +96550664004/+440744222130

Strathclyde Institute of Pharmacy and Biomedical Sciences (SIPBS),

University of Strathclyde,

161 Cathedral St, Glasgow G4 0RE

Glasgow, United Kingdom

Chief Investigator / PhD supervisor details:

Dr. Amanj Kurdi

Reader (Associate Professor)

+00 (0)141 548 2181

amanj.baker@strath.ac.uk

Strathclyde Institute of Pharmacy and Biomedical Sciences (SIPBS),

University of Strathclyde,

161 Cathedral St, Glasgow G4 0RE

Ethical Approvals

The Ministry of Health of Kuwait granted this research ethical approval, and it was endorsed by the SIPBS ethical committee.

If you have any questions or concerns during or after the research or wish to contact an independent person to whom any questions may be directed or further information may be sought, please contact:

Secretary to the University Ethics Committee

Research & Knowledge Exchange Services

University of Strathclyde

Graham Hills Building

50 George Street

Glasgow

G1 1QE

Telephone: 0141 548 3707

Email: ethics@strath.ac.uk

Q1.2 Consent form

Name of department: Strathclyde Institute of Pharmacy and Biomedical Sciences (SIPBS)

Title of the study: Barriers and facilitators of appropriate antimicrobial prophylaxis in gynaecology and obstetrics surgeries Kuwait

Please read each statement below and if you are happy to participate, please click on **agree** and then **next**.

- I confirm that I have read and understood the Participant Information Sheet for the above project, and the researcher has answered any queries to my satisfaction.

- I confirm that I have read and understood the Privacy Notice for Participants in Research Projects and understand how my personal information will be used and what will happen to it (i.e. how it will be stored and for how long).
- I understand that my participation is voluntary and that I am free to withdraw from the project at any time, up to the point of completion, without having to give a reason and without any consequences.
- I understand that I can request the withdrawal from the study of some personal information and that whenever possible, researchers will comply with my request. This includes the following personal data: audio recordings of interviews that identify me; my personal information from transcripts.
- I understand that anonymised data (i.e. data that do not identify me personally) cannot be withdrawn once they have been included in the study.
- I understand that any information recorded in the research will remain confidential, and no information that identifies me will be made publicly available.
- I consent to being a participant in the project.
- I consent to being audio or video recorded as part of the project.

Researcher contact details:

Fahad Alshatti

postgraduate researcher

Fahad.alshatti@strath.ac.uk

telephone: 50664004

I agree, Please add your full name below (1)

I disagree (2)

End of Block: 1.Participant information sheet and consent form

Start of Block: 2.Demographics

Q28 Demographic

Q2.1 What is your gender

Male (1)

Female (2)

Prefer not to say (3)

Q2.2 What is your age

(Please specify in years)

Q2.3 What is your speciality

(Please select one)

Obstetrics and Gynaecology (1)

Anaesthesiology (2)

Other (Please specify) (3)

Q2.4 From which region did you obtain your medical degree

Middle East (Please specify) (1)

Europe (Please specify) (2)

North America (Please specify) (3)

Asia (Please specify) (4)

Other (Please specify) (5)

Q2.5 How many years is it since you graduated from medical school?

Specify in years

Q2.6 Where do you work?

(Select as many as applicable)

Public hospital (1)

Private hospital (2)

Q2.7 What is your current level of practice?

(Please select one)

Consultant (1)

Fellow (2)

Senior registrar (3)

Registrar (4)

Board (please specify) (5)

Trainee (6)

Q14 Preferred method of interview.

Face-Face (2)

Online (ZOOM or Teams) (3)

Q13 Please add your preferred contact details to arrange the meeting (email or phone number)

Q14 Would you like to be informed about the findings of this study? If yes, please provide your email.

Yes, I am interested. (1)

No, I am not interested. (2)

Q29 Please **click next** to end the survey

End of Block: 2.Demographics

3.4 COREQ Checklist

No.	Item	Response	Thesis location
Domain 1: Research team and reflexivity: Personal characteristics			
1	Interviewer/facilitator	Fahad Alshatti (F.A.) Primary investigator and PhD candidate (clinical pharmacist, University of Strathclyde)	<i>Title page</i>
2	Credentials	MPharm (clinical pharmacist); PhD candidate in pharmacoepidemiology	<i>Title page</i>
3	Occupation	Clinical pharmacist and PhD researcher	<i>N/A</i>
4	Gender	Male	<i>N/A</i>
5	Experience and training	Trained in qualitative research methodology as part of doctoral programme.	<i>Chapter 4, section 4.2</i>
Domain 1: Research team and reflexivity: Relationship with participants			
6	Relationship established	No prior relationship between the interviewer and participants. Initial contact made through a communication officer appointed by the OB/GYN chairman, in addition direct contacts with hospital departmental heads	<i>Chapter 4, section.2.4</i>
7	Participant knowledge of the interviewer	Participants were informed that the interviewer was a PhD researcher and clinical pharmacist conducting doctoral research on SAP prescribing in Kuwait through an invitation letter and participation online link through Qualtrics®	<i>Chapter 4, section 4.2.; Appendix 4.2</i>
8	Interviewer characteristics	The interviewer was a researcher from university of Strathclyde and clinical pharmacist, which has no influence on the participants.	<i>Chapter 4, section 4.2.3 and 4.2.7</i>
Domain 2: Study design: Theoretical framework			
9	Methodological orientation and theory	Qualitative exploratory design guided by the COM-B model (Capability, Opportunity, Motivation–Behaviour; Michie et al., 2011). Thematic analysis conducted using Braun & Clarke's (2006) six-phase framework, applied both inductively and deductively within the COM-B structure	<i>Chapter 4, section 4.2.1 to section 4.2.6</i>
Domain 2: Study design: Participant selection			
10	Sampling	Combination of convenient and snowball sampling across public and private sectors and across seniority levels (consultants, senior	<i>Chapter 4, section 4.2.3</i>

		registrars, registrars, assistant registrars). Snowball sampling used to expand the sample via participant referrals	
11	Method of approach	Invitation letter and Qualtrics® link (containing participant information sheet, consent form, demographic questions, and contact details) distributed via a communication officer appointed by OBG/YN chairman and heads of OB/GYN departments in public/private hospitals via WhatsApp®	<i>Chapter 4, 4.2.3 and 4.2.4. Appendix 4.2–4.3</i>
12	Sample size	13 participants. Target of 10 was planned, with 3 additional interviews to confirm data saturation (Francis et al., 2010). Data saturation was confirmed when no new themes emerged	<i>Chapter 4, section 4.2.3</i>
13	Non-participation	No formal record of refusals. Non-response was not further investigated as participation was voluntary	<i>Chapter 4, 4.2.</i>
Domain 2: Study design: Setting			
14	Setting of data collection	Interviews conducted either online via Microsoft Teams® or in-person at the participant's office or a designated meeting room at their workplace, based on participant preference	<i>Chapter 4, Section 4.2.4.1</i>
15	Presence of non-participants	All interviews were conducted one-to-one between the interviewer and participant	<i>Chapter 4, section 4.2</i>
16	Description of sample	13 OB/GYN doctors: 11 public sector, 2 private sector; 3 consultants, 3 senior registrars, 4 registrars, 3 assistant registrars; all practising in Kuwait with mean work experience of 14.7 years (SD + -8.3). The mean age of participants was 39.1 (SD + - 8.3) years.	<i>Chapter 4, section 4.3.1.</i>
Domain 2: Study design: Data collection			
17	Interview guide	Semi-structured topic guide developed based on: (1) published literature on SAP barriers and facilitators (Hassan et al., 2021; Ierano et al., 2019); (2) COM-B model; (3) findings from Chapter 2 (PPS) and Chapter 3 (KAP survey). Guide reviewed by supervisors (AK, AB) and independent academic (ED). Piloted with two OB/GYN clinicians. No	<i>Chapter 4, section 4.2.2; Appendix 4.1</i>

		modifications required post-pilot. Full guide in Appendix 4.1	
18	Repeat interviews	All participants were interviewed once only	<i>Chapter 4, section 4.2</i>
19	Audio/visual recording	All interviews were audio-recorded with participant consent. Recordings transferred to a secure, password-protected University OneDrive® account immediately after each interview and deleted from the recording device	<i>Chapter 4, section 4.2.5</i>
20	Field notes	N/A	<i>N/A</i>
21	Duration	Pilot interviews: less than one hour. Main interviews: ranged from approximately 30 to 60 minutes. Conducted between 25 December 2023 and 25 January 2024	<i>Chapter 4, section 4.2.2 and 4.2.4.1</i>
22	Data saturation	Data saturation was defined as the point at which no new themes emerged during analysis (Francis et al., 2010). Three additional interviews were conducted beyond the initial target of 10 to confirm saturation	<i>Chapter 4, section 4.2.3</i>
23	Transcripts returned to participants	Transcripts were not returned to participants for comment or correction.	<i>Chapter 4, section 4.2.</i>
Domain 3: Analysis and findings: Data analysis			
24	Number of data coders	Three: (1) mainly the primary investigator (F.A.); (2) independent researcher with experience in qualitative research (AF); (3) independent qualitative researcher from outside the health field, a PhD student in psychology (DE)	<i>Chapter 4, section 4.2.6</i>
25	Description of the coding tree	Coding was conducted both inductively (allowing themes to emerge from data) and deductively (using COM-B components as the overarching framework). Codes were organised under COM-B components (themes) and subdomains (subthemes): Physical and Psychological Capability; Physical and Social Opportunity; Reflective and Automatic Motivation.	<i>Chapter 4, section 4.2.6 and 4.3</i>
26	Derivation of themes	Themes were derived both inductively (from the data) and deductively (mapped to COM-B). Initial codes were generated using NVivo® software. Codes were grouped manually, reviewed for	<i>Chapter 4, section 4.2.6</i>

		coherence, and mapped onto the COM-B framework.	
27	Software	NVivo® qualitative data analysis software used for initial coding. Microsoft Word® used for transcription. Qualtrics® used for participant consent and demographics	<i>Chapter 4, section 4.2.4.2, 4.2.5 and 4.2.6</i>
28	Participant checking	Not conducted. Independent coding by two external researchers (AF and DE approximately 46% of transcripts in total), and structured consensus discussion to resolve discrepancies	<i>Chapter 4, section 4.2.6</i>
Domain 3: Analysis and findings: Reporting			
29	Quotations presented	Yes, representative verbatim participant quotes are presented throughout Section 4.3 to illustrate each theme and subtheme. Each quote is attributed to a unique participant ID and role designation (e.g., P8, Senior registrar) to preserve anonymity while maintaining transparency.	<i>Chapter 4, section 4.3</i>
30	Data and findings consistent	Yes. Findings were supported by participant quotations and consistent patterns within the data	<i>Chapter 4, section 4.3</i>
31	Clarity of major themes	Six major themes are reported, organised under the three COM-B domains (Capability, Opportunity, Motivation), each subdivided into subdomains and sub-themes with clear definitions and illustrative quotes. A thematic summary table is provided (Table 4.1)	<i>Chapter 4, section 4.3</i>
32	Clarity of minor themes	Yes, minor themes and contradictory participant views are reported within the relevant subdomain sections. Mixed views (e.g., on punitive vs positive reinforcement approaches) are explicitly acknowledged and discussed	<i>Chapter 4, 4.3.</i>

3.5 Ministry of Health ethical approval for qualitative study



دولة الكويت
وزارة الصحة
وكيل الوزارة المساعد لشئون التخطيط و الجودة



المرجع : ٣٣٠٢
التاريخ : ٢٠٢٢/١٠/٢٦

السيد الفاضل / د. وكيل الوزارة

المحترم

تحية طيبة وبعد،،،،

الموضوع / تسهيل مهمة الباحث / فهد أحمد الشطي – طالب دكتوراة في جامعة
ستراثكلاند – جلاسكو
تحت إشراف

Dr. Amanj Kurdi – Professor / Anne Boyter –
(رقم البحث 2022/2117) تحت عنوان:

Barriers and facilitators of appropriate antimicrobial
prophylaxis in gynaecology and obstetrics surgeries
Kuwait

يرجي التفضل بالإحاطة بأن اللجنة الدائمة لتنسيق البحوث الطبية والصحية
المشكلة بموجب القرار الوزاري رقم 207 لسنة 2012 قد أوصت بإجتماعها
الثامن والثمانون (6/ 2022) المنعقد يوم الثلاثاء الموافق 2022/10/25
بالموافقة على إجراء البحث المقدم من الباحث بتاريخ 2022/9/22.
وذلك بعد أن قامت اللجنة استنادا للقرار الوزاري رقم 207 لسنة 2012 والتعميم
الصادر من السيد / وكيل الوزارة برقم 156 لسنة 2012 باستطلاع آراء الجهات
ذات العلاقة بموضوع البحث حيث وافق السيد / أ. المستشار القانوني بالكتاب رقم 945
بتاريخ 2022/10/5. كما وافق السيد / د. رئيس مجلس أقسام النساء والتوليد بالكتاب
رقم 1035 بتاريخ 2022/10/20.
ويتم البحث من خلال إجراء مقابلات لجمع البيانات عن المؤشرات المستهدفة
بالدراسة حسب بروتوكول البحث.